Chapter 4.0

Process Information

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CHAPTER 4.0
PROCESS INFORMATION

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4.1 PROCESS DESCRIPTION

4.1.1 Process Overview

The Waste Treatment Plant (WTP) will store and treat waste feed from the Hanford Site double-shell tank (DST) system in the pretreatment plant. The pretreatment plant will separate the waste into two feed streams for the low-activity waste (LAW) and high-activity waste (HLW) melters. The term LAW feed generally refers to the supernatant portion of the DST system waste. Feed from the DST system is expected to be of four major waste feed types, or waste feed envelopes. These waste feed envelopes are described as follows:

- Envelope A. This waste feed envelope will contain cesium and technetium at concentrations high enough to warrant removal of these radionuclides during pretreatment, to ensure that the immobilized low-activity waste (ILAW) glass waste meets applicable requirements.
- Envelope B. This waste feed envelope will contain higher concentrations of cesium than envelope A. Both cesium and technetium must be removed to comply with the ILAW specifications. This envelope may also contain concentrations of chlorine, chromium, fluorine, phosphates, and sulfates that are higher than those found in envelope A, which may limit the waste incorporation rate into the glass.
- Envelope C. This waste feed envelope will contain organic compounds containing complexed strontium and transuranics (TRU) that will require removal in a processing step unique to this waste envelope. As with envelopes A and B, cesium and technetium will also require removal in the pretreatment process to ensure that ILAW glass waste meets applicable requirements.
- Envelope D. HLW feed will be in the form of a slurry containing approximately 10 to 200 grams of unwashed solids per liter. The liquid fraction of the slurry will be composed of residues from envelope A, B, or C waste and the solid fraction will be envelope D waste.

The WTP treatment processes are designed to immobilize the waste constituents in a glass matrix by vitrification and to treat the off-gas from the processes to a level that protects human health and the environment.

Two similarly designed vitrification systems will be used in the WTP. One system will immobilize the pretreated LAW feed and the second will immobilize the pretreated HLW feed. The dangerous waste constituents in the melter feed will be destroyed, removed, or immobilized in a glass matrix through the vitrification process. The ILAW and immobilized high level waste (IHLW) produced by the WTP will be in the form of glass packaged in steel containers and placed in permitted treatment, storage, and/or disposal (TSD) facilities.

Secondary waste streams (e.g., radioactive and dangerous solid waste, nonradioactive and nondangerous liquid effluents, and radioactive and dangerous liquid effluents) will be characterized and recycled into the treatment process, transported to permitted TSD facilities located on the Hanford Site, or transported off-site, as appropriate. Nonradioactive dangerous waste will also be generated by laboratory and maintenance activities. This waste will be managed at the WTP until it can be transferred to an off-site TSD unit.

There are four primary components of the process at the WTP: pretreatment, LAW vitrification, HLW vitrification, and the analytical laboratory. In addition, each of these waste treatment processes is supported by systems and utilities known as the balance of facilities (BOF). The following discussion presents an overview of these waste treatment processes and BOF systems at the WTP. Figure 4A-1 presents a simplified process flow figure of the WTP treatment processes.

<u>Pretreatment</u>

The waste feed will be stored and subsequently treated in the pretreatment plant prior to vitrification. The processes in the pretreatment plant will condition waste feed and remove cesium, technetium, strontium, TRU compounds, and entrained solids. The waste feed will also be processed through ultrafiltration to separate the solids.

There will be three types of waste management units in the pretreatment plant, as follows:

- Container storage areas
- Storage and treatment tanks
- Containment buildings

The structure of the pretreatment plant will be supported by a reinforced concrete foundation. The superstructure will be made of structural steelwork with a metal roof. Typically, the process cells within the pretreatment plant will be constructed of reinforced concrete to protect plant operators from radiation. The cell floors and a portion of the cell walls will be lined with stainless steel to provide secondary containment for the process tanks and process piping. Further information regarding secondary containment requirements, management of releases to sumps, and descriptions of sump types is found in Section 4.2.2.

<u>LAW Vitrification</u>

The LAW vitrification plant will house the vitrification systems for production of the ILAW. Four types of waste management units will be located in the LAW vitrification plant, as follows:

- Container storage areas
- Storage and treatment tanks
- Miscellaneous units (LAW melters)
- Containment buildings

The LAW vitrification plant building will be constructed of reinforced concrete and structural steelwork. The below-grade portion of the building structure will be made of reinforced concrete, and the superstructure will be made of reinforced concrete and structural steelwork with a metal roof. The plant structure will be supported by a reinforced concrete mat foundation.

A protective coating will be applied to the concrete floor and walls of the LAW melter gallery. The floor and portions of the cell walls in process rooms that house mixed waste tanks will be lined with stainless steel. The melter pour caves will be completely lined with stainless steel. Further information regarding secondary containment requirements, management of releases to sumps, and descriptions of sump types are found in Section 4.2.2.

HLW Vitrification

The HLW vitrification plant will house the vitrification systems for producing IHLW. Four types of waste management units will be located in the HLW vitrification plant, as follows:

- Container storage areas
- Treatment tanks
- Miscellaneous unit (HLW melter)
- Containment buildings

The HLW vitrification plant will be constructed of reinforced concrete and structural steelwork. The below-grade portion of the building structure will be of reinforced concrete construction, and the superstructure will be made of structural steelwork with a metal roof. The plant structure will be supported by a reinforced concrete mat foundation. The cell and cave floors and a portion of the cell and cave walls will be lined with stainless steel to provide secondary containment for the process tanks. Further information regarding secondary containment requirements, management of releases to sumps, and descriptions of sump types are found in Section 4.2.2.

Balance of Facilities (BOF)

The BOF will include, by definition, support systems and utilities required for the waste treatment processes within the four main process areas (pretreatment, LAW vitrification, HLW vitrification, and laboratory). The BOF support systems and utilities will include, but not be limited to, heating and cooling, process steam, process water, chilled water, primary and secondary power supplies, and compressed air. Regulated waste management units within the BOF include the HLW out-of-service melter storage area, the LAW out-of-service melter storage area, the nonradioactive dangerous waste storage area, and the central waste storage facility.

4.1.2 Pretreatment Plant

The pretreatment plant is designed to receive mixed waste from the DST system and separate and prepare the LAW and HLW feed streams for vitrification. The main functions performed at the pretreatment plant are as follows:

- Receive waste feeds from the Hanford Site DST system.
- Separate cesium, strontium, technetium, and TRU radionuclides from the waste feeds.
- Segregate solids into the HLW feed stream.
- Concentrate the separated radionuclides.

- Adjust the concentration of the waste for vitrification.
- Collect and monitor liquid effluents.
- Blend waste fractions to optimize treatment steps.

The purpose of this section is to describe the major systems associated with the pretreatment plant. Descriptions of process systems, ventilation systems, and mechanical support systems associated with the pretreatment plant are provided in the following sections.

Figure 4A-1 presents the simplified flow figure for the WTP, Figure 4A-2 presents the simplified flow of primary process systems, and the following figures, found in Appendix 4A, provide additional detail for the pretreatment plant:

- Simplified process flow figures for process information
- Typical system figures depicting common features for each regulated system
- Simplified general arrangement figures showing locations of equipment and associated tanks
- Waste management area figures showing plant locations to be permitted
- Contamination/radiation area boundary figures showing contamination/radiation zones throughout the plant

4.1.2.1 Waste Feed Receipt Process System (FRP)

The FRP receives waste from the DST system and pretreatment waste processing, facilitates sampling of the waste, provides lag storage, and transfers the waste feed for subsequent treatment within the pretreatment plant.

The main components of the FRP are:

- Four waste receipt vessels (V11020A, V11020B, V11020C, and V11020D)
- A cell containing the receipt vessels, including containment and ventilation features
- Waste sampling equipment
- Receipt tank mixing and transfer components
- Piping associated with waste receipts and transfers

Waste is received from the DST system through the inner pipe of any one of three co-axial transfer pipes. These pipes, equipped with leak detection systems within the outer pipe, allow receipt of the waste into the four receipt vessels. Piping is also available to allow transfer of waste from one receipt vessel to another, as well as allowing storage and return of treated waste from within the pretreatment plant.

The waste receipt vessels are of stainless steel construction. Each tank is equipped with pulsejet mixers to mix the vessel contents and suspend solids. Reverse flow diverters are provided for each vessel to transfer the waste, and each is equipped with an automated sampling system to allow confirmation of the individual tank waste characteristics. Waste receipt vessels are vented to the Pretreatment Vessel Vent Process System (PVP).

The cell containing the receipt vessels is partially lined with stainless steel to form a secondary containment. This secondary containment will accommodate up to 100 % of the volume of the largest vessel in the cell and will have a gradient (minimum 1%) designed to channel fluids to a sump. This sump is equipped with liquid level detection and alarm capabilities and an ejector to allow transfer of waste detected. Cell and vessel wash capabilities are installed for decontamination activities. The receipt vessels have internal wash rings for this purpose.

Instrumentation, alarms, controls, and interlocks will be provided for the FRP to indicate or prevent the following conditions:

- Vessel contents overflow (level indication, controls, and passive overflow routes to the contingency vessels)
- Inadvertent gas/steam flowing into the vessel or being generated causing pressurization (vessels vented to the vessel vent system, temperature indication)
- Loss of system integrity (vessel and sump level indications)
- Loss of mixing function (air pressure/flow indication)
- Vessel overflow (transfers from DST and into vessels not permitted if level is high because it may cause overflow)
- Inadvertent transfer (WTP permissive signals to transfer pumps operated by the tank farm contractor)
- High temperature or level in the system that could compromise system integrity (instruments, alarms)
- Inaccurate tank level (density compensator to adjust waste level indicated to actual level)

4.1.2.2 Waste Feed Evaporation Process System (FEP)

The primary functions of the FEP are to receive waste from the FRP and miscellaneous recycle streams, to evaporate a portion of the feed (reducing the volume and increasing the sodium concentration), to transfer the waste to the Ultrafiltration Process System (UFP), to condense the overhead vapors and transfer the condensate to the Radioactive Liquid Waste Disposal System (RLD), and to vent non-condensable gases to the PVP for treatment.

The FEP is composed of two evaporator trains arranged in parallel. The evaporator trains can be operated independently or at the same time depending on the evaporation needs.

The main components of the FEP are:

- Two evaporator feed vessels (V11001A and V11001B)
- Two evaporator trains, each composed of a waste feed evaporator separator vessel (V11002A and V11002B) with demisters, a reboiler, a recirculation pump, and overhead condensers

- Single evaporator condensate pot (V11005)
- Pumps and associated piping for transfer of waste

The waste feed evaporators are forced-circulation units operating under vacuum to reduce the operating temperature. Each evaporator feed vessel has a pulsejet agitation system to provide mixing and to prevent settling of solids. The waste feed from the feed vessels is pumped continuously to the evaporator.

A pump maintains a high flow rate around the evaporation system. The pump transfers the waste through the reboiler and back into the waste feed evaporator separator vessel. The recirculating waste stream is prevented from boiling in the reboiler tubes by maintaining sufficient hydrostatic head to increase the boiling point above the temperature of the liquor in the reboiler.

As the liquid travels through the reboiler, the hydrostatic head diminishes and flash evaporation occurs as the flow enters the waste feed evaporator separator vessel. The liquid continues to flash and the vapor and liquid streams are separated. The liquid stream circulates in this closed loop and becomes more concentrated, while the vapor stream passes to the evaporator overheads system. The concentrate off-take comes from a pump and is discharged to evaporator concentrate buffer vessels (V12010A and V12010B) in the UFP.

The vapor stream from the evaporator is condensed in the overhead system which contains a three-stage condenser system consisting of a primary condenser, an inter-condenser, and an after-condenser. The non-condensables from the after-condenser pass through the demister, which removes entrained droplets. The non-condensables are then routed to the PVP for treatment. The condensed vapor from the overhead system is collected in a condensate pot and then transferred to process condensate vessels in the Radioactive Liquid Waste Disposal System (RLD) for discharge to the Liquid Effluent Retention Facility (LERF) and/or the Effluent Treatment Facility (ETF). If the condensate does not meet the LERF/ETF waste acceptance criteria, the condensate from the system is recycled back through the waste feed evaporation system.

Instrumentation, alarms, controls, and interlocks will be provided for the FEP to indicate or prevent the following conditions:

- Vessel contents overflow (level indication, controls, and passive overflow routes to the contingency vessels)
- Inadvertent gas/steam flowing into the vessel or being generated causing pressurization (vessels vented to the vessel vent system, temperature indication)
- Loss of system integrity (vessel and sump level indications)
- Loss of mixing function (air pressure/flow indication)
- High temperature or high level in the system that could compromise system integrity (instruments, alarms)

4.1.2.3 Ultrafiltration Process System (UFP)

The UFP separates the concentrated waste feed from the evaporator system into a high solids stream, referred to as the HLW feed stream and a solids free stream, the LAW feed stream. The separated solids may undergo additional treatment (washing and/or leaching operation). These operations will be performed in the UFP system. In addition, the LAW feed stream may require Sr/TRU removal. This operation will also be performed in the UFP system prior to solids separation.

The main components of the UFP system are:

- Two evaporator concentrate buffer vessels (V12010A and V12010B) each equipped with pulse jet mixers and cooling jackets
- Two concentrate transfer pumps
- Two ultrafiltration feed vessels (V12011A and V12011B) each equipped with pulse jet mixers and cooling jackets
- Two ultrafilter feed pumps
- Two ultrafilter trains, each containing three individual ultrafilter units [(G12002A, G12003A, G12004A) and (G12002B, G12003B, G12004B)]
- Associated ultrafilter backpulsing equipment
- Three LAW permeate hold vessels (V12015A, V12015B, V12015C) each equipped with pulse jet mixers

Ultrafiltration is a filtration process in which the waste stream is processed axially through the ultrafilters, which are long bundles of permeable tubes. Solids free liquids pass radially through the permeable ultrafilter tubes surface while the concentration of the solids in the recirculating stream continuously increases. The resulting solids slurry may need treatment such as caustic leaching and/or water washing to reduce interstitial liquid buildup to minimize the quantity of glass produced.

Waste is received from the FEP into the evaporator concentrate buffer vessels (V12010A and V12010B) of the UFP system. The waste may be sampled here to determine the Ultrafiltration parameters. For Envelope C feeds, chemicals are added to the evaporator concentrate buffer vessel to precipitate strontium and TRU elements contained in the incoming waste stream prior to solids concentration by ultrafiltration. Heat (if required) and agitation are applied to ensure that the precipitation process is completed.

The solids free stream generated by Ultrafiltration is designated as the LAW feed stream, which is then routed to one of the three LAW permeate hold vessels (V12015A, V12015B, or V12015C). Here, the permeate is sampled for solids prior to further processing, which includes cesium and technetium removal and additional evaporation prior to LAW vitrification.

The concentrated slurry may then be washed with process water or caustic leached to remove interstitial liquid, soluble salts, and/or HLW glass limiting compounds and further processed through the ultrafilter. The concentrated solids stream, or HLW feed stream, is transferred to the lag storage vessels (V12001D and V12001E) of the HLW Lag Storage and Feed Blending System (HLP) and then on to the HLW vitrification process. The treated solids may also be returned to the DST system via the FRP.

During waste processing, the permeability of the ultrafilters is reduced over time. Re-establishing the ultrafilters' permeability can be accomplished using one of two different methods which include backpulsing with filter permeate or cleaning utilizing nitric acid or caustic. Backpulsing may be utilized while the filter is in operation, but cleaning requires the filters to be out of operation. Filter performance will be monitored to determine when cleaning is required.

Instrumentation, alarms, controls, and interlocks will be provided for the UFP system as follows:

- Vessels have level instrumentation with high alarms and trip functions to minimize the chances of overflowing
- Vessels have a designated overflow route designed to handle the largest possible flow rate into the vessels
- Level instrumentation and overflow piping with alarm set points will be used to prevent the overfilling of the vessels and subsequent liquid discharge into the vessel vent system
- In case of an in-cell equipment failure, the waste will remain within the secondary containment (C5 cell) which will have an engineered route back into the process
- Leaks will be detected via sump instrumentation

4.1.2.4 HLW Lag Storage and Blending Process System (HLP)

The HLW HLP receives the HLW feed stream from the UFP. It provides lag storage for the high solids slurry and blends HLW vitrification feed prior to transfer and subsequent processing in the HLW vitrification plant. The system also provides for blending of cesium and technetium recovered from the LAW treatment process into the HLW feed stream prior to transfer to the HLW vitrification plant.

The main components of the HLP are:

- Strontium/TRU lag storage vessels (V12001A and V12001C)
- Lag storage vessels (V12001D and V12001E)
- HLW feed blending vessel (V12007)
- Associated pumps and piping

High solids waste, designated as the HLW feed stream, is received from UFP and stored in the lag storage vessels. The waste stored in these vessels is sampled to determine blending and to comply with vitrification parameters of IHLW. In the HLP, strontium/TRU precipitate slurry is segregated from the other HLW slurry, and stored in the strontium/TRU lag storage vessels.

The HLW feed stream is routed from the lag storage tanks to the HLW feed blending vessel. The HLW feed blending vessel also receives cesium and technetium that has been recovered from the LAW feed stream in the waste treatment process. The cesium and technetium addition rates to the HLW feed stream are controlled based upon the results of the sampling previously conducted in the HLW lag storage vessels. The final blended HLW feed stream is then transferred to the HLW vitrification plant for final treatment and immobilization. Alternatively, the blended HLW feed stream may be returned to the DST system.

Instrumentation, alarms, controls, and interlocks will be provided for the HLP as follows:

- Vessels have level instrumentation with high alarms and trip functions to minimize the chances of overflowing
- Vessels have a designated overflow route designed to handle the largest possible flow rate into the vessels
- Level instrumentation and overflow piping with alarm/trip set points will be used to prevent the overfilling of the vessels and subsequent liquid discharge into the vessel vent system
- In case of an in-cell equipment failure, the waste will remain within the secondary containment (C5 cell) which will have an engineered route back into the process
- Leaks will be detected via sump instrumentation located in the cell sump

4.1.2.5 Cesium Ion Exchange Process System (CXP)

The primary function of the CXP is to remove cesium from the LAW feed stream. This is accomplished using a series of ion exchange columns containing a resin that preferentially extracts cesium. Elution of the cesium-loaded resin is accomplished using dilute nitric acid. . The cesium-loaded nitric acid is then routed to the Nitric Acid Recovery Process System (CNP) with the cesium ultimately processed in the HLW melter.

The main components of the CXP are:

- Four cesium ion exchange columns (C13001, C13002, C13003, and C13004) for cesium removal
- LAW feed vessel (V13001)
- Caustic rinse collection vessel (V13008)
- Two treated LAW transfer pumps

Other equipment includes a vessel for receipt and transfer of the caustic rinse. Transfer of the caustic rinse is accomplished using reverse flow diverters. In addition, the cesium reagent vessel is used to supply demineralized water and caustic solutions, as well as to supply reagents (nitric acid, demineralized water, and caustic solution) for elution.

The CXP uses four columns operating in series. At any given time, only three of the ion exchange columns are operating in the loading cycle, removing cesium from the LAW feed stream, for purposes of column loading efficiency. The order of the columns may be rotated in series so that any of the columns may be in the lead position. The remaining ion exchange column is being eluted and regenerated, having its spent resin replaced, or is regenerated and in a standby mode. After a lead column is eluted, it typically becomes a lag column in the next loading cycle.

The concentration of cesium in the feed stream is monitored prior to and following each ion exchange column. When cesium is detected above an established set point following an ion exchange column, that column is taken out of the loading cycle, eluted, and the resin bed regenerated while the other columns are placed into the loading cycle.

Elution is part of a resin bed regeneration cycle that typically includes the following steps:

- Displacement of residual LAW feed stream in the column by rinsing with dilute caustic solution to prevent the potential of precipitating aluminum hydroxide from the LAW feed stream at low pH values. This caustic rinse is collected in the caustic rinse collection vessel.
- Displacement of residual dilute caustic solution from the column with demineralized water to prevent an acid-base reaction during elution.
- Elution of cesium ions with dilute nitric acid.
- Displacement of residual acid from the column with demineralized water to prevent an acid-base reaction with the caustic rinse.
- Regeneration of the resin with caustic solution.

After a number of loading and regeneration cycles, the resin is expected to lose performance and is termed “spent.” The number of cycles depends on LAW feed constituents, operating temperatures, properties of the resin, radiation exposure, and LAW feed throughput rates. The spent resin is slurried with recycled resin flush solution and flushed out of the column into the Spent Resin Collection and Dewatering Process System (RDP) for resin disposal. A slurry of fresh resin is prepared in the Cesium Resin Addition Process System (CRP) and then added to the column as a ion exchange column bed replacement.

A standby elution system is provided by three tanks; one containing nitric acid, another containing demineralized water, and a third tank containing sodium hydroxide. Each tank has a volume sufficient to fully elute one fully loaded column, and one partially loaded column. The tanks are located at an elevation sufficiently high above the ion exchange columns to provide enough hydrostatic head to flow through the reagent vessel, pumps, one of the ion exchange columns, and associated piping.

Instrumentation, alarms, controls, and interlocks will be provided for the CXP to indicate or prevent the following conditions:

- Overfilling: Vessels are protected against overfilling by liquid level indication, and high-level instrumentation interlocks to shut off feed sources, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.
- Overheating: Temperature regulation is provided to the ion exchange columns by a chilled water supply that operates continuously. Temperature indication is provided on each ion exchange column, and chilled water return lines will be monitored for flow.
- Leakage of process liquids into chilled water: Chilled water return lines will be monitored for contamination.
- Overpressurization: Pressure relief for each ion exchange column is provided by a relief valve that discharges to a piping header that is vented to the LAW feed vessel.
- Loss of containment: Vessels are protected against containment loss by liquid level indication, high-level interlocks to shut off feed sources, and PCS control and alarm functions, as required. The cell, which drains to a sump, contains liquid leakage in this system. The cell is lined with stainless steel, and sump level instrumentation detects liquid leakage into the cell.
- Inadvertent transfers of fluids: System sequential operations are properly interlocked to prevent inadvertent transfers at the wrong time or location.
- Reverse flow diverter failure: Where needed, system vessels using reverse flow diverters incorporate dual reverse flow diverter system redundancy into the design to prevent loss of process function and to maintain appropriate liquid levels in vessels if one of the reverse flow diverters should fail.
- Column hydrogen venting: Each column is provided with a separate vessel to continuously collect and vent hydrogen generated in the columns. Hydrogen is vented through a restriction orifice to the vessel vent system. Air is continually purged into the vapor space in the hydrogen venting vessel to ensure that the concentration of hydrogen is maintained in an acceptable range.

4.1.2.6 Cesium Nitric Acid Recovery Process System (CNP)

The CNP recovers nitric acid that was previously used for cesium ion exchange resin bed regeneration so that the nitric acid can be reused. In addition, this system concentrates and transfers to storage the cesium extracted from the ion exchange system for incorporation into the HLW melter feed.

The main components of the CNP are:

- The evaporator and reboiler
- A rectifier column
- Primary and after-condensers
- A pulse pot
- Cesium concentrate lute pot (V13030)
- Eluate contingency storage vessel (V13073)

- Recovered nitric acid vessel (V13028)

During the process of regenerating the cesium ion exchange resin beds, eluate composed of cesium-bearing nitric acid will be fed to the nitric acid recovery evaporator operating under reduced pressure. A closed-loop circulation stream is fed from the evaporator to the steam heated reboiler and back to the evaporator. This heat input is the motive force for the evaporative process.

Vapors from the evaporator, composed primarily of water and nitric acid, are sent to the refluxed rectifier column where the nitric acid is recovered. Recovered nitric acid is collected in the recovered nitric acid vessel for reuse in the regeneration of cesium ion exchange column resin beds. Water vapor is recovered from the system's primary and after-condenser routed through the waste feed evaporator, and collected in the Plant Wash and Disposal System (PWD). These condensers are water cooled shell-and-tube heat exchangers. The effluent collected from these condensers is neutralized before being recycled to the Treated LAW Evaporator Process System (TLP). Uncondensed vapors exiting from the after-condenser are routed to the PVP for further treatment.

The cesium concentrated in the evaporator is routed to the HLW feed blending vessel (V12007), for blending and incorporation into the HLW melter feed stream. This cesium concentrate may also be stored in the eluate contingency storage vessel which is equipped with cooling coils for heat removal.

Because the cesium nitric acid recovery evaporator operates under reduced pressure, the feed stream to the evaporator is passed through a pulse pot and enters the evaporator through the cesium concentrate lute pot. This process maintains the negative pressure on the evaporator system. The concentrated cesium stream extracted from the evaporator also passes through the cesium concentrate lute pot.

Some nitric acid is consumed during the elution process requiring that fresh acid be added to the recovered nitric acid stream to bring the contents back to the original volume. Depending on the concentration of the recovered acid sample, some pH adjustment may be necessary. Fresh nitric acid is delivered to the recovered nitric acid vessel, as necessary.

The CNP only operates when a cesium ion exchange column is in the process of having its resin bed regenerated through an elution process. When elution of a cesium ion exchange column is not taking place, the nitric acid recovery system is maintained in a standby mode. The major vessels of the CNP are equipped with internal wash rings for decontamination of the system.

Instrumentation, alarms, controls, and interlocks will be provided for the CNP to indicate or prevent the following conditions:

- Overfilling: Vessels are protected against overfilling by liquid level indication, high-liquid-level instrumentation interlocks to shut off feed sources, and PCS control functions with hard-wired trips, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.

- Cooling system failure in concentrate storage vessel: Due to the heat generated in the eluate contingency storage vessel from cesium decay, two cooling coils (one operating and one spare) with a cooling water supply are provided for temperature control. If a failure should occur in the cooling water system, the vent system is designed to remove adequate heat to delay the advent of boiling of the concentrate. A process water line is available for makeup water to the vessel to counteract evaporation of the water in the concentrate.
- Loss of containment: Vessel containment loss is detected by liquid level indication in the cell sump, and in the event of an extremely low liquid level, PCS controls and alarms will function as required, including shutoff of feed sources. The cell, which drains to a sump, contains liquid leakage in this system, and a steam ejector is used to empty the sump as needed. The cell is lined with stainless steel.
- Loss of cooling water to condenser: If there is a loss of normal cooling water, and backup cooling water is not available, the vacuum ejectors system and the evaporator will automatically shut down.
- Inadvertent transfers of fluids: System sequential transfer operations are interlocked.

4.1.2.7 Cesium Resin Addition Process System (CRP)

The purpose of the CRP is to provide a means to add fresh resin to the cesium ion exchange columns. The system provides for preparation of the fresh cesium resin by hydraulically removing fines from the bulk of the resin particles, as well as transfer to the ion exchange columns as a slurry, by gravity flow. The cesium resin is chemically conditioned after transfer to a column. The CRP is located at a point over the cesium ion exchange columns which allows optimum operational efficiency.

Cesium is removed from the LAW feed using the ion exchange resin. Each batch of the resin has a limited useful operating life after which it must be removed from the ion exchange column and replaced with fresh resin.

Fresh resin is delivered per specification by the vendor. It is then transferred from bulk storage with the aid of handling/conveying equipment to a feed hopper mounted on the top of the cesium resin addition vessel. The cesium resin undergoes resin conditioning processes in the cesium ion exchange columns; therefore, only water is added prior to adding the cesium resin into the vessel. The resin is transferred to an ion exchange column as a slurry by gravity flow.

There is an air gap vessel, located on the slurry downcomers to the cesium ion exchange columns in the resin addition valve bulge. The function of the air gap vessel is to prevent back-flow of potentially contaminated gas, resin, or liquid, caused by a leaky or misaligned valve, from feeding back into the resin addition vessel. In the unlikely event of back-flow into the air gap vessel, gas is vented to the PVP and other constituents overflow into the plant wash vessel.

The cesium resin must be conditioned before processing the LAW feed stream through the ion exchange column. The purpose of conditioning is to fully expand the resin and convert the resin into the right ionic form for cesium removal. The cesium ion exchange resin is conditioned in the ion exchange column to utilize disposition of the acidic and caustic conditioning solutions through plant processes.

Instrumentation, alarms, controls, and interlocks will be provided for the CRP indicate or prevent the following conditions:

- Pressure in cesium resin addition vessel: High pressure will alarm; interlock to check vessel status and readiness to receive resin.
- Level in cesium resin addition vessel: Vessel is equipped with level controller; alarms at high level and low level; appropriate transfer valves automatically close.
- Pressure in cesium resin addition vessel: At a set pressure level, the pressure is released into the vessel area.
- Vacuum in cesium resin addition vessel: At a set pressure level, atmospheric air is drawn in.
- Level in cesium resin overflow tank: At high level, flow from the screen is shut off.
- Overflow recycle pump discharge pressure: Alarms at low discharge pressure; the operator checks on the operation of the pump. A low-low pressure will alarm.
- Differential pressure across the fines overflow filter: A high differential pressure indicating a plugged filter will be alarmed. A low differential pressure indicates failure of the filter.

4.1.2.8 Technetium Ion Exchange Process System (TXP)

The primary function of the TXP is to remove technetium from the LAW feed stream. This is accomplished using a series of ion exchange columns containing a resin that preferentially extracts technetium.

The main components of the TXP are:

- Four technetium ion exchange columns (C43006, C43007, C43008, and C43009) for technetium removal
- Three treated LAW buffer vessels (V43110A, V43110B, and V43110C)
- A technetium ion exchange buffer vessel (V43001)
- A caustic rinse collection vessel (V43056) with reverse flow diverters
- Two technetium feed pumps and associated piping

Other equipment associated with this system includes the technetium reagent vessel for caustic solutions and process water addition and two transfer pumps for reagents and water flushes.

The TXP uses four columns operating in series. At any given time, only three of the ion exchange columns operate in the loading cycle, removing technetium from the LAW feed stream. The order of these columns may be rotated in series so that any of the columns may be in the lead position. The remaining ion exchange column is being eluted, having its spent resin replaced, or is in a standby mode. After a lead column is eluted, it typically becomes a lag column in the next loading cycle.

The concentration of technetium in the treated LAW is monitored between columns and on the inlet line to the treated LAW buffer vessels. When technetium is detected above an established set point following an ion exchange column, that column is taken out of the loading cycle and the resin bed is regenerated, while the column that was out of service is returned to the loading cycle.

Elution is part of the resin bed regeneration cycle that typically includes the following steps:

- Displacement of residual LAW feed in the column by rinsing with dilute caustic solution to prevent the precipitation of aluminum hydroxide.
- Rinsing of the ion exchange column with process water to prevent caustic from mixing with eluate that is transferred to the technetium eluant recovery system during the elution step.
- Elution of sodium pertechnetate on the loaded resin with warm water from the eluant recovery system.
- pH adjustment of the resin bed by flushing with sodium hydroxide solution to prevent precipitation of aluminum hydroxide during subsequent LAW feed processing.

The eluate from the resin bed regeneration is collected and transferred to the Technetium Eluant Recovery Process System (TEP) for recycling. The concentration of technetium in the eluate is monitored until only limited concentrations of technetium are detected in the eluate leaving the column. The process water eluate is sent to the technetium eluate receipt vessels for further processing to recover the concentrated technetium product. The water is recovered in the technetium eluant recovery system for reuse as eluant.

After a number of loading and regeneration cycles the resin is expected to lose performance and is termed “spent.” The number of cycles depends on LAW feed constituents, operating temperatures, properties of the resin, radiation exposure, and LAW feed throughput rates. The spent resin is slurried with recycled resin flush solution and flushed out of the column to the Spent Resin Collection and Dewatering Process System (RDP). A slurry of fresh resin is then added to the column as a bed replacement.

Instrumentation, alarms, controls, and interlocks will be provided for the TXP to indicate or prevent the following conditions:

- Overfilling: Vessels are protected against overfilling by liquid level indication, and high-level instrumentation interlocks to shut off feed sources, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.
- Overpressurization: Pressure relief for each ion exchange column is provided by a relief valve that discharges to a piping header that is vented in the technetium reagent vessel.

- Loss of containment: Vessels are protected against containment loss by liquid level indication, low-level interlocks to shut off feed sources and PCS control and alarm functions, as required. The cell, which drains to a sump, contains liquid leakage in this system. The cell is lined with stainless steel, and sump level instrumentation detects liquid leakage into the cell.
- Inadvertent transfers of fluids: System sequential operations are properly interlocked to prevent inadvertent transfers at the wrong time or location.
- Reverse flow diverter failure: Where needed, system vessels using reverse flow diverters incorporate dual reverse flow diverters system redundancy into the design to prevent loss of process function and to maintain appropriate liquid levels in vessels if one of the reverse flow diverters should fail.
- Column venting: The valves for each ion exchange column are interlocked with the column vent valve so that the vent valve closes when feed valves open to the ion exchange column. Similarly, the vent valve is closed during spent resin removal. The vent valve opens when a column is idle.

4.1.2.9 Technetium Eluant Recovery Process System (TEP)

The TEP recovers water from the eluate that was previously used for technetium ion exchange resin bed regeneration so that it may be reused. In addition, this system concentrates and transfers to storage the technetium extracted from the ion exchange system for incorporation into the HLW melter feed.

The main components of the TEP are:

- Technetium eluant recovery evaporator (V43069) and reboiler
- A rectifier column
- Primary and after-condensers
- A pulse pot
- Technetium concentrate lute pot (V43072)
- Eluate contingency storage vessel (V13073, included in the Cesium Nitric Acid Recovery Process System [CNP])
- Recovered technetium eluant vessel (V43071)

During the process of regenerating the technetium ion exchange resin beds, eluant composed primarily of technetium-bearing water will be fed to the technetium eluant recovery evaporator operating under reduced pressure. A closed loop circulation stream is fed from the evaporator to the steam heated reboiler and back to the evaporator. This heat input is the motive force for the evaporative process.

Vapors from the evaporator, composed primarily of water vapors, are sent to the refluxed rectifier column, where the majority of the water is recovered in the rectifier column underflow. This recovered water is collected in the recovered technetium eluant vessel for reuse in the regeneration of technetium ion exchange column resin beds. Additional water vapors are recovered from both of the systems condensers (primary and after-condenser) and the condensate is routed to the Plant Wash and Disposal System (PWD). These condensers are water cooled shell-and-tube heat exchangers. Uncondensed vapors exiting from the after-condenser are routed to the PVP for further treatment.

The technetium concentrated from the evaporator is routed to the HLW feed blending vessel (V12007), for blending and incorporation into the HLW melter feed stream. The technetium concentrate from the evaporator can alternatively be stored in the eluate contingency storage vessel.

Because the technetium eluant recovery evaporator operates under reduced pressure, the feed stream to the evaporator is passed through a pulse pot and enters the evaporator through a lute pot. This process maintains the negative pressure on the evaporator system. The concentrated technetium stream extracted from the evaporator also passes through a lute pot.

The TEP only operates when a technetium ion exchange column is in the process of having its resin bed regenerated through an elution process. When elution of a technetium ion exchange column is not taking place, the TEP is maintained in a standby mode. The major vessels of the TEP are equipped with internal wash rings for decontamination of the system.

Instrumentation, alarms, controls, and interlocks will be provided for the CRP indicate or prevent the following conditions:

- Overfilling: Vessels are protected against overfilling by liquid level indication, high liquid level instrumentation interlocks to shut off feed sources, and PCS control functions with hard-wired trips, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.
- Loss of containment: Vessel containment loss is detected by liquid level indication in the sump. In the event of an extremely low liquid level in a process vessel, PCS control and alarms will function as required, including shutoff of feed sources. The cell, which drains to a sump, will contain liquid leakage in this system, and a steam ejector is used to empty the sump as needed. The cell is lined with stainless steel.
- Loss of cooling water to condenser: If there is a loss of normal cooling water, and backup cooling water is not available, the vacuum ejectors system and the evaporator will automatically shut down.
- Inadvertent transfers of fluids: System sequential transfer operations are interlocked.

4.1.2.10 Technetium Resin Addition Process System (TRP)

The purpose of the system is to provide a means to add fresh resin to the technetium ion exchange columns. The TRP provides for preparation of the technetium resin by hydraulically removing fines from the bulk of the resin particles. The system also provides for transfer to the ion exchange columns as a slurry by gravity flow. The resin is chemically conditioned in the ion exchange column. The system is located at a point over the technetium ion exchange columns which allows optimum operational efficiency.

Technetium is removed from the LAW feed stream using an ion exchange resin. Each batch of the resin has a limited useful life after which it must be removed from the ion exchange column and replaced with fresh resin.

Fresh resin is added to, prepared in, and slurried for transfer from the technetium resin addition vessel. Process water is added to make up the required slurry which is gently agitated mechanically to suspend the fine particles. Next, fines are removed from the slurry. The resin is gravity transferred as a slurry to the technetium ion exchange columns. The conditioning process involves soaking the resin in caustic. There is an air gap vessel located at the four slurry downcomers to the technetium ion exchange columns in the resin addition valve bulge. The function of each air gap vessel is to prevent back-flow of potentially contaminated gas, resin, or liquid, caused by a leaky or misaligned valve, from feeding back into the resin addition vessel.

Instrumentation, alarms, controls, and interlocks will be provided for the TRP indicate or prevent the following conditions:

- Pressure in technetium resin addition vessel: High pressure will alarm; interlock to check vessel status and readiness to receive resin.
- Level in technetium resin addition vessel: Vessel is equipped with level controller; alarms at high level and low level; appropriate transfer valves automatically close.
- Pressure in technetium resin addition vessel: At a set pressure level, the pressure is released into the vessel area.
- Vacuum in technetium resin addition vessel: At a set pressure level, atmospheric air is drawn in.
- Level in technetium resin overflow tank: At high level, flow from the screen is shut off.
- Overflow recycle pump discharge pressure: Alarms at low discharge pressure; the operator checks on the operation of the pump. A low-low pressure will alarm.
- Differential pressure across the fines overflow filter: A high differential pressure indicating a plugged filter will be alarmed. A low differential pressure indicates failure of the filters.

4.1.2.11 Treated LAW Evaporation Process System (TLP)

The primary functions of the TLP are as follows:

- Receive waste from the treated LAW collection vessels following technetium removal
- Receive and neutralize submerged bed scrubber purge from LAW vitrification
- Evaporate a portion of the feed (reducing the volume and increasing the sodium concentration)
- Transfer the waste to the Treated LAW Concentrate Storage Process System (TCP)

- Condense the overhead vapors and transfer the condensate to the Radioactive Liquid Waste Disposal System (RLD)
- Vent non-condensable gases to the PVP for treatment

The TLP is composed of a single evaporator train and contains the following main components:

- Two LAW submerged bed scrubber purge receipt vessels (V45009A and V45009B)
- A single evaporator train composed of the LAW evaporator separator vessel (V41011) equipped with demisters, a reboiler, a recirculation pump, and overhead condensers
- A single evaporator condensate pot (V41013)
- Pumps and associated piping for transfer of waste

The treated LAW evaporator is a forced-circulation unit operating under a vacuum to reduce the operating temperature. The treated LAW from the TXP will be transferred to the TLP. The treated LAW buffer vessels (V43110A/B/C) will be configured in such a way that one will be filling, one will be feeding the LAW evaporator separator vessel, and one will be full, empty, or out-of-service. Submerged bed scrubber purge liquor from the LAW vitrification plant is received and neutralized in one vessel while being fed to the LAW evaporator separator vessel from another vessel. Additionally, off-specification effluent may be received from the Plant Wash and Disposal System (PWD).

The two feeds to the LAW evaporator separator vessel are pumped continuously to the recirculation pump.

The recirculation pump maintains a high flow rate around the evaporation system. The recirculation pump transfers the waste through the reboiler and back into the LAW evaporator separator vessel. The recirculating waste stream is prevented from boiling in the reboiler tubes by maintaining sufficient hydrostatic head to increase the boiling point above the temperature of the liquor in the reboiler.

As the liquid travels through the reboiler, the hydrostatic head diminishes and flash evaporation occurs as the flow enters the LAW evaporator separator vessel. The liquid continues to flash and the vapor and liquid streams are separated. The liquid stream circulates in this closed loop (becoming more concentrated), while the vapor stream passes to the evaporator overhead system.

The concentrated waste stream is pumped continuously out of the evaporator system. The concentrate off-take is situated on the suction line of the recirculation pump. The concentrated waste stream is discharged to the treated LAW buffer vessels (V43110A/B/C).

The vapor stream from the evaporator is condensed in the overheads system which contains a multi-stage condenser system consisting of a primary condenser, an intercondenser, and an aftercondenser. The non-condensables from the aftercondenser pass through the demister, which removes entrained droplets. The non-condensables are then routed to the PVP for treatment.

The condensed vapor from the overheads system is collected in a condensate pot and then transferred to process condensate vessels in the RLD for discharge to the ETF. If contaminated, the condensate from the system is recycled back through the TLP.

Condensate from the primary condenser is monitored continuously for activity. In the event of activity breakthrough being detected, a treated LAW evaporator system shutdown is initiated and the contents of the evaporator condensate pot are transferred to a LAW submerged bed scrubber purge receipt vessel.

The evaporator recirculation pump will not automatically be stopped in case of a treated LAW evaporator process system shutdown. This is to prevent settling of solids within the recirculation loop, which may cause a blockage.

Instrumentation, alarms, controls, and interlocks will be provided for the TLP indicate or prevent the following conditions:

- High level in separator vessel: Stop evaporator feed pumps.
- Low level in separator vessel: Stop concentrate take-off pumps.
- Breakthrough detected in condensate pot: Close clean condensate transfer valves and recycle contaminated condensate to receipt vessel.
- Low level in condensate pot: Close condensate transfer valves.

4.1.2.12 Treated LAW Concentrate Storage Process System (TCP)

The primary functions of the TCP are to receive treated waste from the pretreatment process, to provide buffer storage capacity, and to transfer waste to the LAW vitrification plant.

The main components of the TCP are:

- LAW buffer storage vessel (V41001) equipped with steam injection heating
- Pulse jet mixer
- Transfer pump and associated piping

Treated LAW concentrate is normally received by the LAW buffer storage vessel from the treated LAW evaporator in the TLP.

Pulsejet mixers will agitate the contents of the LAW buffer storage vessel. Agitation of tank contents ensures that solids in the treated LAW concentrate are suspended prior to transfer, improves heat transfer into the solution from steam injection, and prevents the settling of solids. The temperature of the LAW buffer storage vessel will be monitored and controlled with steam injection to avoid precipitation of solids.

Treated LAW concentrate will be transferred to the LAW vitrification plant via pipelines within underground trenches. A duty and standby pipeline will be installed to minimize disruptions to facility throughput in the event of a leak. The pipelines will be coaxial to detect and contain leaks. Following a treated LAW concentrate transfer, the pipe will be flushed with two pipe volumes of water to clear the line and minimize the chance of the line blocking. The transfer pipe and annulus will drain to a Plant Wash and Disposal System (PWD) vessel.

The following list provides an overview of the safety and interlock features for the TCP:

- Normal operation control at high level: Stop PCS controlled transfer sequence.
- Failure of the PCS to stop transfer sequence: PCS software trip and alarm on PCS sources of feed.
- Failure of PCS software: If required, the hardwired trip would act on PCS sources of feed and on isolation valves.

4.1.2.13 Spent Resin Collection and Dewatering Process System (RDP)

The RDP provides for the periodic removal of spent cesium and technetium ion exchange resin and the subsequent replacement with fresh resin.

The primary components of the RDP include:

- Two spent resin collection vessels (V43135A and V43135B)
- A resin flush collection vessel (V43136)
- Resin dewatering moisture separation vessel

The spent resin collection process is initiated by flushing an eluted ion exchange column and hydraulically discharging the contents into either of two spent resin collection vessels. In these vessels, the resin slurry will be circulated, monitored for cesium and technetium content, and delivered to a sampling system to determine whether the resin is in compliance with the receiving TSD unit's waste acceptance criteria. Resin that does not meet the predetermined treatment limits for cesium and technetium content will be routed back to the ion exchange columns for re-elution. Spent resins that meet the receiving TSD unit's waste acceptance criteria will be dewatered, containerized, and stored within the pretreatment plant until transferred to a Hanford TSD unit.

At times, internal decontamination of vessels may be required. The vessels are fitted with wash rings for decontamination by flushing. Wash systems will be able to introduce water, caustic, and acid. The stainless steel-clad cell is also fitted with a cladding wash system for decontamination of the walls and floor.

<u>Spent Resin Removal</u>
Spent resin is removed from each ion exchange column independently as a batch operation. Resin is first eluted and then hydraulically discharged under pressure from the ion exchange column by fluidizing the bed of resin with a flush liquor (demineralized water or caustic

solution). The resin flush liquor is stored in the resin flush collection vessel and is delivered to the ion exchange columns by transfer pump.

Spent resin slurry from the ion exchange columns is collected in the two spent resin collection vessels. In order to obtain good resin fluidization and subsequent transfer to the resin dewatering container, water above the resin is recirculated through eductors installed inside each vessel at two levels. The function of the upper eductors located in the water above the settled resin bed is to create the jet mixing action and necessary velocity to initiate the mixing of resin and water. The lower eductors induce vortexes over the entire vessel volume to assure uniform suspension of the resin. Process water may be used as necessary to adjust the resin concentration. No additional fresh water is introduced into the vessels until lines are flushed at the end of a resin transfer.

The spent resin from the spent resin collection vessels is transferred to the dewatering container by recirculating the liquid through mixing eductors and into the resin bed at the bottom of the collection vessels. The recirculating resin is monitored for cesium (gamma) or technetium (beta) by radiation monitors to determine if cesium and technetium have been sufficiently removed from the resin for disposal. Spent resin that contains cesium in excess of allowable limits is recycled to a cesium ion exchange column for an additional elution cycle. Spent resin that contains technetium in excess of allowable limits is recycled to a technetium ion exchange column for an additional elution cycle. After completing the additional elution cycle, the resin is transferred back to the spent resin collection vessels where it again begins recirculation. The spent resin is also analyzed to assure it complies with the receiving TSD unit's waste acceptance criteria.

Resin Dewatering

Following assurance that the spent resin is in compliance with the receiving TSD unit acceptance criteria, the pump discharge to the dewatering container is opened to fill the waste container to a predetermined level. When the transfer operation is completed, process water is used to flush resin remaining in the transfer pump and line to the dewatering container and the suction line is flushed back into the two spent resin collection vessels.

First, a gross dewatering removes excess water while the resin is pumped to the container and after it enters the container. Next, a dewatering vacuum pump is used to remove water from the resin. The container filtration system includes a moisture separator vessel. Circulation of a warm, dry air stream through the spent resin picks up moisture. The moist air stream is cooled and circulated to the moisture separation vessel where the moisture (water droplets) is separated. The blower sucks the dry air from the separation vessel and circulate the air to the resin again. When the water content in the resin is reduced to an acceptable level, the resin is dewatered.

The resin flush collection vessel receives flush liquor from the resin dewatering operation, and also receives resin transport liquor from the cesium and technetium ion exchange columns during the addition of fresh resin. The streams are stored for reuse as resin flush liquor. If the combined inputs into the resin flush collection vessel exceed its storage capacity, then the excess liquor is recycled to the Waste Feed Evaporator Process System (FEP). A resin flush transfer pump can be used to recirculate liquor to the resin flush collection vessel in order to mix the contents of the vessel and allow for sampling prior to transfer of the flush liquor to the resin flush collection vessel.

Instrumentation, alarms, controls, and interlocks will be provided for the RDP indicate or prevent the following conditions:

- Overfilling: System vessels and the dewatering container are protected against overfilling by liquid level indication, high-level instrumentation interlocks to shut off feed sources, and PCS control functions backed up by hard-wired trips as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.
- Loss of containment: Vessels are protected against containment loss by liquid level indication, and by PCS control and alarm functions as required, including shut-off of feed sources. The cell, which drains to a sump, will contain liquid leakage in this system. The cell is lined with stainless steel and sump liquid level instrumentation will detect liquid leakage into the cell.
- Inadvertent transfers of fluids: System sequential operations are properly interlocked to prevent inadvertent transfers at the wrong time or location.
- Loss of pumping function: Operation of pumps is not permitted or pumps are shut down if there is indication that the pumping system has plugged, lost its integrity, or ceased to function properly, or if pumping/receiving vessel conditions warrant a pump shutdown. These conditions could be indicated by:
  - High or no electrical current indication
  - Abnormal pumping/receiving vessel conditions

4.1.2.14 Pretreatment Maintenance

The pretreatment plant will include a maintenance facility that will enable remote and hands-on maintenance of wet process equipment, and will consist of the following systems.

- Pretreatment In-Cell Mechanical Handling System (PIH)
- Pretreatment Filter Cave Handling System (PFH)
- Radioactive Solid Waste Handling System (RWH)

The individual systems and their primary functions are described below:

Pretreatment In-Cell Mechanical Handling System (PIH)
The purpose of this system is to provide a method for performing maintenance on process equipment in the process gallery hot cell. The equipment in the system will perform the following functions:

- Lifting, holding, transporting, installing/uncoupling process equipment and failed in cell cranes and powered manipulators

- Disassembling, repairing and reassembling failed contaminated process equipment remotely
- Providing fixtures for holding components while doing work
- Decontamination and monitoring to contaminated equipment

Typical process equipment that the system will handle are pumps, valves, jumpers, small vessels, and ancillary equipment and/or tools. Maintenance equipment requiring periodic servicing by this system will include cranes, manipulators, and decontamination and disassembly tools from the radioactive solid waste handling system.

Equipment in this system will include:

- Overhead cranes
- Manipulators (powered and manual)
- Shield and airlock doors
- Size reduction equipment (cutters, shears, etc.)
- Associated support equipment, like impact wrenches and spreader bars
- Retrieval docking mechanism
- Fixtures
- Fasteners
- Decontamination equipment (carbon dioxide, wash down, flushing, dunk tank)
- Assembly/disassembly tools used in repair: these tools will be used by only the manipulators

Pretreatment Filter Cave Handling System (PFH)

The purpose of this system is to provide a method for performing maintenance on ventilation equipment in the filter cave hot cell. The equipment in this system will provide the following functions:

- Lifting, holding, transporting, installing/uncoupling primarily filters, some process equipment, and failed in-cell cranes and powered manipulators
- Providing fixtures for holding components for while doing work
- Operation of some manual valves
- Decontamination and monitoring to contaminated equipment
- Size reduction equipment (filter crushing)

Typical process equipment the PFH will handle are HEPA and high efficiency mist eliminator filters, and valves, inside the cell. Maintenance equipment requiring periodic servicing by this system will include cranes, manipulators, and decontamination and disassembly tools.

Equipment in this system will include:

- Overhead cranes
- Manipulators (powered and manual)
- Shield and airlock doors
- Associated support equipment, like impact wrenches and spreader bars
- Retrieval docking mechanism
- Fixtures
- Fasteners
- Decontamination equipment (carbon dioxide, wash down)
- Assembly/disassembly tools used in repair: these tools will be used by only the manipulators

Radioactive Solid Waste Handling System (RWH)

The purpose of this system is to provide a means to dispose of radioactive contaminated equipment. This system interfaces with in-cell handling, filter cave handling, and the spent resin dewatering system. The main functions the RWH provides are:

- Lifting, holding, transporting, disposal containers
- Packaging disposal containers and preparing the containers for shipping
- Decontamination of waste and cleaning and remote monitoring of disposal containers
- Temporary shielding and confinement barriers

Typical process equipment the system will handle are failed process equipment, such as pumps and valves, filters, jumpers, and maintenance equipment.

Equipment in this system will include:

- Overhead cranes
- Manipulators (manual)
- Carts for transporting waste containers
- Associated support equipment, like impact wrenches and spreader bars
- Decontamination systems, such as carbon dioxide and dunk tanks
- Fixtures
- Remote radioactive monitoring
- Temporary shielding and confinement barriers used for packaging
- Disposal containers

4.1.2.15 Plant Wash and Disposal System (PWD)

The primary function of the PWD is to receive, store, and transfer effluent. It will collect plant wash, drains, and acidic or alkaline effluent from the pretreatment plant.

The primary components of the PWD include:

- Alkaline effluent vessels (V15013 and V15018)
- Plant wash vessel (V15009A)
- Primary and secondary acidic/alkaline effluent vessels (V45013 and V45018)
- C3 drain collection vessel (V15319)
- HLW effluent transfer vessel (V12002)
- Ultimate overflow vessel (V15009B)

Plant Wash Vessel

During operations, plant wash and drain effluents will be collected and mixed in with other effluents in the plant wash vessel prior to transfer. The solution will be analyzed for pH and excess acidic effluent will be neutralized. Effluents will be recycled to the Waste Feed Evaporation Process System (FEP).

The level, temperature, and pH in the plant wash vessel, as well as the temperature in each of the ten plant wash breakpots, are monitored in the central control room. Pulse-jet mixers are used to provide a uniform mixture during neutralization within the plant wash vessel. Excess acidic effluent is neutralized with sodium hydroxide supplied from a reagent bulge. Wash rings are used for vessel and breakpot washing. Vessel-emptying ejectors may be used for transfers to the secondary acidic/alkaline effluent vessel via a breakpot.

A reverse flow diverter supplies a representative sample of the contents of the plant wash vessel for analysis. If the pH is confirmed to be approximately 12 or above, reverse flow diverters transfer the effluent from the plant wash vessel to the evaporator feed vessels (V11001A or V11001B). Normally, the plant wash vessel has priority over the primary and secondary acidic/alkaline effluent vessels when transferring effluent to the FEP.

The plant wash vessel, as well as the breakpots, vent to PVP, via a vessel vent scrubber and the vessel vent header. An air in-bleed is provided to dilute hydrogen generated through radiolysis in the plant wash vessel.

Acidic/Alkaline Effluent Vessels

High-activity acidic and alkaline effluent is received, stored, and neutralized in the primary acidic/alkaline effluent vessel or the secondary acidic/alkaline effluent vessel prior to transfer. The primary and secondary acidic/alkaline effluent vessels will receive wastes from those sources listed on the process flow figures in Appendix 4A.

In both vessels, the acidic and alkaline effluents will be mixed to neutralize the effluents. The mixture will be analyzed and neutralized, if necessary. When the effluent meets the predetermined pH value, it will be transferred to the FEP, for recycling.

The system vessels are designed to withstand the anticipated heat of reaction generated by mixing the effluents. Normally, only low concentrations of acidic and caustic solutions will be mixed during operations, keeping the temperature within design limits. Higher concentrations of acidic and caustic effluents may be mixed during operations, with a greater increase in heat generation. The system will monitor temperature rise in the vessels and will automatically stop the effluent receipt when the temperature reaches a predetermined set point within design limits.

The level, temperature, and pH in the primary and secondary acidic/alkaline effluent vessels, as well as the temperature in each of the primary acidic/alkaline effluent breakpots and the secondary acidic/alkaline effluent breakpot, are monitored in the central control room. Pulse jet mixers are used to provide a uniform mixture during neutralization within these vessels. Excess acidic effluent is neutralized with sodium hydroxide supplied from a reagent bulge. Wash rings are used for vessel and breakpot washing. A vessel-emptying ejector may be used for transfers to the plant wash vessel.

Reverse flow diverters supply a representative sample of the contents of the primary and secondary acidic/alkaline effluent vessels for analysis. If the pH is confirmed to be approximately 12 or above, reverse flow diverters transfer the HLW effluent from the primary and secondary acidic/alkaline effluent vessels to the FEP vessels.

<u>Alkaline Effluent Vessels</u>

The alkaline effluent vessels primarily receive caustic scrubber purge from LAW vitrification and effluents from the TXP. The effluents are sampled, and if they meet acceptability requirements, they are sent to RLD. If it does not meet the requirements, the effluent is sent to the TLP.

The level, conductivity, radioactivity, and pH in the alkaline effluent vessels are monitored in the central control room.

<u>C3 Drain Collection Vessel</u>

The C3 drain collection vessel receives floor drains and floor sumps from C3 areas. The effluents are transferred to the plant wash vessel for treatment.

<u>HLW Effluent Transfer Vessel</u>

The HLW effluent transfer vessel receives HLW acidic wastes from HLW vitrification line drains from HLW vitrification/pretreatment plant interface lines, and laboratory drains. These effluents can be transferred to the plant wash vessel to recover the effluents back into the process system.

<u>Ultimate Overflow Vessel</u>

The ultimate overflow vessel receives overflows from vessels in the pretreatment plant. Additionally, this vessel receives line drains and flushes. The vessel operating level is maintained below a predetermined level to allow the vessel to hold 30 minutes of overflow at the highest transfer rate within the facility.

The PWD vessels, as well as the breakpots, vent to the PVP via a vessel vent scrubber and the vessel vent header. An air in-bleed is provided to dilute hydrogen generated through radiolysis in the PWD vessels.

Instrumentation, alarms, controls, and interlocks will be provided for the PWD indicate or prevent the following conditions:

- Overfilling. Vessels are protected against overfilling by liquid level indication, high liquid level instrumentation interlocks to shut off feed sources, and PCS control functions with hard-wired trips, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.
- Loss of containment. Vessel containment loss is detected by liquid level indication in the sump. In the event of an extremely low liquid level in a process vessel, PCS controls and alarms will function as required, including shutoff of feed sources. The cell, which drains to a sump, will contain liquid leakage in this system and a steam ejector is used to empty the sump as needed. The cell is lined with stainless steel.
- Inadvertent transfers of fluids. System sequential transfer operations are interlocked.

4.1.2.16 Radioactive and Non-Radioactive Liquid Waste Disposal System (RLD and NLD)

The primary function of the RLD system is to receive, store, and transfer contaminated liquid effluents. The RLD will receive low-activity radioactive and/or dangerous waste effluents.

The primary components of the RLD include:

- Two process condensate vessels (V45028A and V45028B)
- Pumps, piping, and instrumentation for transfers

The RLD primarily receives effluent from the Caustic Scrubber purges from the LAW vitrification plant via the PWD, FEP, and the TLP. These effluents are the condensed vapors removed from the waste streams. Liquid effluents from the systems will be recycled or discharged to the Hanford Site LERF and then transferred to the ETF.

Prior to transfer to the LERF/ETF, the effluent will be sampled to assure compliance with the waste acceptance criteria of the facility. If analysis determines that the effluent is outside the waste acceptance criteria, it will be returned to the PWD for reprocessing.

Clean condensates may also be routed back to the pretreatment plant as process water makeup. Alternatively to discharging to the RLD, effluents from the pretreatment plant that are not radioactively contaminated and that designate as dangerous waste may be transferred to the NLD.

Vessels in the RLD system will be vented to the PVP.

Instrumentation, alarms, controls, and interlocks will be provided for the RLD indicate or prevent the following conditions:

- Overfilling: Vessels are protected against overfilling by liquid level indication, high liquid level instrumentation interlocks to shut off feed sources, and PCS control functions with hard-wired trips, as required. Overflow piping from each vented vessel prevents liquid from entering the vent system.
- Loss of containment: Vessel containment loss is detected by liquid level indication in the sump. In the event of an extremely low liquid level in a process vessel, PCS control and alarms will function as required, including shutoff of feed sources. The cell, which drains to a sump, will contain liquid leakage in this system and a steam ejector is used to empty the sump as needed. The cell is lined with stainless steel.
- Inadvertent transfers of fluids: System sequential transfer operations are interlocked.

4.1.2.17 Pretreatment Plant Vessel Vent Process System (PVP)

The pretreatment plant off-gas treatment systems consist of the following major systems:

- Pretreatment Vessel Vent Process System (PVP)
- Process Vessel Vent Extraction (PVV)

The PVP will treat two off-gas streams. One stream will be from pretreatment vessel vents (tanks and other vessels), and the other stream will be exhaust from reverse flow diverters and pulsejet mixers. Both off-gas streams will be collected and treated separately within the PVP. Following treatment in the PVP, the off-gas streams will proceed to the PVV where the streams will be sampled and discharged through separate flues within the pretreatment plant stack.

The functions of the PVP are to remove solids, liquid droplets, and mists from the off-gas; prevent condensation in the HEPA filters; absorb soluble gases; and treat volatile organic gases. The ventilation systems upstream and downstream of the PVP are important to, and integral with, the functioning of the PVP. Upstream of the PVP will be an air inlet system that regulates air in-bleed rates to each process vessel. The motive force is provided by the ventilation fans downstream of the vessel vent system. The PVP, in combination with upstream and downstream systems, provides the radiolytic hydrogen control strategy for the pretreatment plant. The PVV will maintain continuous operation to provide the hydrogen control function, and will use backup power generators for the exhaust fans.

The off-gas streams flow through a network of subheaders (piping) to two major collection headers. The two off-gas streams will be separated because the reverse flow diverter/pulse jet mixer exhaust stream will have a much higher flow rate with a significantly lower concentration of radionuclides and volatile constituents then the vessel ventilations. Separating these two air streams will allow better control of pressures and exhaust airflow rates, as well as minimizing the size of emission abatement equipment (volatile organic compounds oxidation unit, carbon beds, and scrubber).

The PVP will include a caustic scrubber, high efficiency mist eliminator (high efficiency mist eliminator), a volatile organic compounds oxidation unit, and carbon bed adsorbers. The reverse flow diverter/pulse jet mixer off-gas is treated through a high efficiency mist eliminator before going to the PVV. After treatment in the PVP, both treated off-gas streams will proceed, separately, to the PVV. The extract system for both streams includes a hot air injection system with electric heating coils and backflow HEPA filters. Downstream of the hot air injection the PVV includes HEPA filters, extract fans, stack air stream monitoring, and the exhaust stack. Although the volatile organic compounds oxidation unit and the carbon bed adsorbers will be part of the PVP, they will be located between the HEPA filters and the extract fans, both of which are part of the PVV.

The following sections provide descriptions of the PVP components:

- Vessel vent header collection vessel (V15052)
- Condensate collection vessel (V15038)
- Two high efficiency mist eliminator drain collection vessels (V15326 and V15327)
- Air inlet (air purge system)
- Collection (exhaust piping system)
- Vessel vent caustic scrubber
- High efficiency mist eliminators and pre-heaters
- Volatile organic compounds oxidation unit
- Carbon bed adsorbers

<u>Air inlet (air purge system)</u>
Because the pretreatment process system design is an airtight design, the overall gas exhaust flow (except for evaporation, boiling, etc.) is directly dependent on the air purge rates provided to each individual process vessel.

Continuous air purge to process vessels is the primary control strategy for radiolytic produced hydrogen. Additional airflow above the minimum hydrogen control rate may be introduced to each vessel to help balance the system and ensure that vessels are obtaining the minimum required flow. Additional airflow above the minimum for hydrogen dilution will also be introduced to individual vessels to remove heat by evaporative cooling. This function will help prevent boiling of self-heating tanks during an extended shutdown.

The air inlet header system is fitted with HEPA filters, isolation valves (to change HEPA filters if needed), balance and control valves to regulate flow, and a flow measurement device. Each inlet header will obtain air, at atmospheric pressure, from a C3 area and flow to a group of tanks supplied by that subheader. The supply lines are designed for the desired balance and total flow regulated at the inlet by the valves. The HEPA filters protect the C3 area from contamination in the event of reverse airflow, but airflows and balance will be designed to prevent reverse flow.

The air inlet headers will supply air to groups of vessels, initially each process cell. The supply air arrangement will be independent of the exhaust air gathering system.

Collection (exhaust piping system)

From the individual process vessels a vent line routes exhaust gases to a subheader, usually one for each cell or group of vessels within a cell. The connection to the subheaders from the process vessels are arranged, where possible, to maintain airflow from normally lower activity vessels to (or past) normally higher activity levels vessels. This will help prevent contamination of lower activity vessels due to potential reverse flow, or in-breathing. The subheader locations and the overall flow scheme will also be influenced by the plant layout and by the physical location of the major vessel vent headers.

Final sizing of the individual exhaust vent lines will be determined by airflow, process pump capacities for filling vessels, and other potential pressurization scenarios. The individual exhaust vent lines, the subheaders, and the headers will also be sized to minimize overall pressure drop and help balance the system.

Vessel Vent Caustic Scrubber

The vessel vent exhaust streams will be collected for treatment in the caustic scrubber. The scrubber removes radioactive aerosols, acid gases, and NO_x emissions. The caustic scrubber will be a column with a bed filled with packing material. Sodium hydroxide solution flows down through the bed while the off-gas enters the bottom and is drawn up through packing and caustic solution. Contact between the gas and the liquid in the bed causes a portion of the NO_x in the vent gas to dissolve and form sodium nitrate. The scrubbing liquor collects in the sump of the column, and excess overflows to pretreatment effluent collection.

The caustic scrubber solution is recirculated by a pump. A pipe from the base of the scrubber leads to the pump suction and returns liquid to the column above the top of the packing. Above this point there is another packed section with very fine packing rings that acts as a disentrainment section to prevent caustic loss. There is a water wash ring above the disentrainment section in the column to wash accumulated caustic solid off the packing. Fresh caustic is supplied to the unit by a metering pump from the reagents system.

Demineralized water will be added to the scrubber, when needed, through the wash rings. Excess recirculation solution from the scrubber will be routed to pretreatment effluents. After leaving the scrubber, the off-gas flows to the high efficiency mist eliminators. Positioning the scrubber ahead of the high efficiency mist eliminators saturates the gas flow and enables the high efficiency mist eliminators to avoid damage from dry operation. The scrubber is provided with a bypass line and valve. The bypass function is to permit continued operation of the hydrogen control system in the unlikely event the scrubber becomes plugged or disabled, or during maintenance activities.

The vessel vent caustic scrubber generates the liquid purge stream based on the absorption and cooling of the incoming vent exhausts from various vessels in the pretreatment plant. The vessel vent scrubber recirculation pump transfers, by batch, the scrubbing liquid purge stream once a day to the PWD. The scrubbing liquid purge stream transfers the accumulated condensate, radiolytic particulates and salts from the recirculating scrubbing liquid stream in the vessel vent scrubber.

High Efficiency Mist Eliminators and Pre-heater

The high efficiency mist eliminator will be composed of regenerable deep-bed fiber filters configured in an annular shape to remove fine aerosols. Gas flows from the outside to the inside hollow core, where the treated gas exits at the top and the liquid collects at the sealed bottom in a drainpipe. The high efficiency mist eliminator will operate wet so that as the liquid aerosols accumulate they form a liquid film on the filter element, which then drops to the drain. Intermittent water spraying of the filter elements will be used to treat the vessel vent off-gas stream.

Three separate high efficiency mist eliminators will treat the vessel vent off-gas streams. The pulse jet mixer/reverse flow diverter has four separate high efficiency mist eliminators, three in-service, and one offline. This configuration will permit washing each high efficiency mist eliminator while it is offline. The high efficiency mist eliminator effluent will be discharged to a drain vessel and then to an effluent vessel.

After treatment in a high efficiency mist eliminator, the vessel ventilation off-gas stream will be heated by the hot air injection system. The hot air injection system draws air through HEPA filters from a C3 area. The air is heated with an electric inline heater so that the combined air stream will be above its dewpoint to prevent condensation in the PVV HEPA filters. The HEPA filters in the hot air injection line protect against backflow of contamination into the C3 area and protect the heaters from contamination for maintenance.

The hot air injection system begins the PVV; it also includes HEPA filters, extract fans, stack air stream monitoring, and the exhaust stack. The volatile organic compounds oxidation unit and the carbon bed adsorbers will be part of the PVP, but they will be located between the HEPA filters and the extract fans, both of which are part of the PVV.

Volatile Organic Compound Oxidation Unit

To remove volatile organics compounds and in the vessel vent stream, a catalyst skid mounted unit with a thermal catalytic oxidizer unit will be used. In this unit, organic compounds are oxidized to carbon dioxide, water vapor, and possibly acid gases (depending on the halogenated volatile organic compound present in the stream).

As the off-gas enters the unit, it travels through the heat recovery unit, which is a plate heat exchanger. The heating medium used is the exhaust from the thermal catalytic oxidizer unit. The cool off-gas enters the cold side of the heat recovery, then passes through an electric heater to bring the temperature up to that required for the volatile organic compound catalyst to operate.

Oxidation of organic compounds is an exothermic reaction therefore it significantly increases the off-gas temperature. This hot off-gas then enters the hot side of the heat recovery unit to heat the incoming off-gas. The cooled off-gas stream is then directed to the carbon bed adsorbers for further volatile organic compounds treatment.

Carbon Bed Adsorbers

Two parallel carbon beds are provided in the design. The carbon beds will further reduce volatile organic compounds from the vessel vent off-gas stream. The volatile organic compounds oxidation unit is designed to remove most of the volatile organic compounds from the vessel vent and the carbon beds will remove the remaining volatile organic compounds. A bypass line and valve is included in the event both units are out of service or are not needed. Normal operation will be one unit online while the other is in maintenance and regeneration mode.

Typical safety design features included in the PVP/PVV are as follows:

- The cell will be lined and provided with a washing system for decontamination purposes
- The cell will be provided with a shielded access plug to allow the use of observation equipment
- The design of the vessel vent lines will take into consideration the hydrostatic level (to prevent liquid from entering the system)
- The collection piping conveying vent system off-gases from the vessel vents, reverse flow diverters, and pulse jet mixers will be designed and routed in accordance with a process piping design guide
- Traps will be fitted with water flush capability in order to clear potential line blockages
- The local drainage sump will have an alarm/start set point to prevent flooding

4.1.2.18 Pretreatment Plant Ventilation

Pretreatment plant ventilation includes the following systems:

- C1 Ventilation System (C1V)
- C2 Ventilation System (C2V)
- C3 Ventilation System (C3V)
- C5 Ventilation System (C5V)

The primary consideration in the design of the ventilation systems is to confine airborne sources of contamination to protect human health and the environment from exposure to hazardous materials during normal and abnormal operating conditions. Physical barriers or structures supported by the ventilation systems will ensure that before air is released to the environment and residual contamination is well below acceptable, safe levels for public exposure.

The pretreatment plant will be divided into four numbered zones, listed below, with the higher number indicating greater radiological hazard potential that needs greater control or restriction. The ventilation system zoning is based on the classifications assigned to building areas for potential contamination. Zones classified as C5 are potentially the most contaminated, such as the pretreatment cells. Zones classified as C1 are uncontaminated areas.

The confinement provided by physical barriers is enhanced by the ventilation system, which creates a pressure gradient and causes air to flow through engineered routes from an area of lower contamination potential to an area of higher contamination potential. There will be no C4 areas in the pretreatment plant. The cascade system, in which air passes through more than one area, will reduce the number of separate ventilation streams and hence, the amount of air requiring treatment.

C1 Ventilation System (C1V)

C1 areas are normally occupied. C1 areas will typically consist of administrative offices, control rooms, conference rooms, locker rooms, rest rooms, and equipment rooms. C1 areas will be operated slightly pressurized relative to atmosphere and other adjacent areas.

C2 Ventilation System (C2V)

C2 areas typically consist of non-process operating areas, access corridors, and control/instrumentation, and electrical rooms. Filtered air will be supplied to these areas by the C2 supply system and will be cascaded into adjacent C3 areas or HEPA filtered and exhausted by the C2 Exhaust system.

C3 Ventilation System (C3V)

C3 areas normally will be unoccupied, but operator access during maintenance will be allowed. C3 areas typically will consist of filter plant rooms, workshops, maintenance areas, and monitoring areas. Access from a C2 area to a C3 area will be via a C2/C3 subchange room. Air will generally be drawn from C2 areas and cascaded through the C3 areas into C5 areas. In general, air cascaded into the C3 areas will be from adjacent C2/C3 subchange rooms. In some areas, where higher flow may be required into C3 areas, a dedicated C2 supply will be provided with a backdraft damper on the C2 supply duct, which will be closed in the event of a loss of C3 extract. This system will shut down should there be a failure of the C5 Exhaust System.

C5 Ventilation System (C5V)

The pretreatment plant C5 areas are designed with the cell or cave perimeter providing radiation shielding as well as a confinement zone for ventilation purposes. C5 areas typically consist of a series of process cells where waste will be stored and treated. The pretreatment plant hot cell will house major pumps and valves and other process equipment. Air will be cascaded into the C5 areas, generally from adjacent C3 areas, and extracted by the C5 extract system. The C5 Exhaust System will be composed of Primary and Secondary HEPA filters and variable speed fans. Fans designed to maintain continuous system operation will drive the airflow. This system will also be interlocked with the C3 HVAC system, to prevent backflow by shutting down the C3 system if the C5 HVAC system shuts down.

4.1.3 LAW Vitrification

The purpose of this section is to describe the major systems associated with the LAW vitrification plant. This plant will consist of several process systems designed to perform the following functions:

- Store pretreated LAW waste slurry
- Convert blended LAW waste slurry and glass formers into molten glass
- Provide melter off-gas treatment systems
- Provide ILAW container handling systems
- Provide ILAW container finishing systems
- Provide storage areas for ILAW containers
- Provide supporting equipment for the melter
- Provide miscellaneous waste handling systems
- Provide LAW vitrification plant ventilation systems

Figure 4A-1 presents the simplified flow figure for the WTP, Figure 4A-3 presents the simplified flow of primary process systems, and the following figures found in Appendix 4A provide additional detail for the LAW vitrification plant:

- Simplified process flow figures for process information
- Typical system figures depicting common features for each regulated system
- Simplified general arrangement figures showing locations of equipment and associated tanks
- Waste management area figures showing plant locations to be permitted
- Contamination/radiation area boundary figures showing contamination/radiation zones throughout the plant

Descriptions of the LAW vitrification process, melter off-gas treatment systems, and ILAW glass container handling systems are provided in the following sections.

4.1.3.1 LAW Melter Feed

The LAW melter feed consists of the following systems:

- LAW Concentrate Receipt Process System (LCP)
- LAW Melter Feed Process System (LFP)
- Glass Former Reagent System (GFR)

The LCP and LFP prepare feed for the LAW melters to produce a vitrified product. An analysis of the waste determines a glass additive formulation for the conversion of the waste to glass. The glass additives specified in the formulation are weighed and mixed with the waste. There are three melter feed trains to supply the three LAW melters. Each melter feed train consists of a melter concentrate receipt vessel, a melter feed preparation vessel, and a melter feed vessel. The LCP includes the melter concentrate receipt vessels. The LFP includes the melter feed preparation vessel and the melter feed vessel for each of the three melters.

The LAW melter feed consists of the following vessels:

- Melter concentrate receipt vessels (V21001, V21002, V21003)
- Melter feed preparation vessels (V21101, V21201, V21301)
- Melter feed vessels (V21102, V21202, V21302)

Melter Concentrate Receipt Vessels

The melter concentrate receipt vessels receive melter feed concentrate from the pretreatment plant. The melter feed preparation vessels are located in three process cells, and each process cell contains a concentrate receipt vessel, a feed preparation vessel, and a melter feed vessel. Each vessel is equipped with the following:

- Mechanical agitator
- Two pumps to transfer LAW concentrate
- Instrumentation for liquid level and density measurement
- Liquid level instrument
- Thermowell/temperature sensor for temperature measurement
- Internal wash rings
- Overflow to C3/C5 drain/sump collection vessel
- Spare nozzles

Valves are located in the valve bulge. Valving in each bulge allows the LAW concentrate to be routed to the feed preparation vessels, or to the plant wash vessel if the concentrate receipt vessel is being cleaned out or if the contents of that vessel cannot be satisfactorily processed.

Glass Former Reagent System (GFR)

The GFR contains the glass former feed hoppers that receive blended glass formers and sucrose by dense-phase pneumatic conveyors from the LAW transporters located at the glass formers room. Each feed hopper is equipped with a pneumatic blending head at the base of the hopper to re-blend the glass former feed.

The feed hoppers are equipped with filters to remove the dust from air used for pneumatic conveying and blending. It is anticipated that a series of single filter cartridges will be mounted on the top of the hoppers. The filters are cleaned by introducing compressed air through the cleaning nozzle to blow accumulated dust back into the hoppers.

The feed hoppers are equipped with load cells to weigh the glass formers to confirm that the material in the upstream blending silo is conveyed to the feed hoppers and to confirm that the glass formers are transferred out of the feed hoppers to the melter feed preparation vessels.

After the blending cycle the glass formers are gravity-fed with a rotary feeder into the melter feed preparation vessels, where the blended glass formers are mixed with the waste. This equipment is located in an isolated area that serves as a contamination barrier between the melter feed preparation vessels and the glass former supply. The rotary valve controls the rate of glass former addition into the melter feed preparation vessels.

Melter Feed Preparation Vessels

The melter feed preparation vessels mix LAW concentrate from the melter concentrate receipt vessels with glass formers and sucrose from the glass former feed hoppers. The vessels are equipped with the following:

- Mechanical agitator
- Two pumps
- Instrumentation for liquid level and density measurement
- Liquid level instrument
- Thermowell/temperature sensor for temperature measurement
- Internal wash rings
- Overflow to the cell sump
- Spare nozzles

The two pumps transfer waste via a valve bulge. Valves in the valve bulge allow melter feed to be routed to the associated melter feed vessel, or to the plant wash vessel. The vessel contents can be circulated through the pump and injected back into the tank in the recirculation mode.

Melter Feed Vessels

The melter feed vessels receive blended melter feed, consisting of LAW concentrate and glass formers, from the melter feed preparation vessels. The vessels are equipped with the following:

- Mechanical agitator
- Pumps to transfer feed to the corresponding LAW melter
- Pump
- Instrumentation for liquid level and density measurement
- Liquid level instrument
- Thermowell/temperature sensor for temperature measurement
- Miscellaneous solution addition line
- Internal wash rings

- Overflow to the cell sump
- Spare nozzles

The pump transfers waste through a valve bulge. Valving in the bulge allows the waste to be routed to the corresponding melter feed preparation vessel in the event of melter shutdowns, to the same melter feed vessel to re-circulate for sampling, or to the plant wash vessel for vessel clean-out. The normal transfer is from the pump to the melter.

The LAW concentrate receipt vessels, the LAW melter feed preparation vessels, and LAW melter feed vessels will have instrumentation and interlocks to indicate or prevent the following conditions:

- Vessel overflow
- Loss of vessel integrity
- Loss of agitator function
- Agitator not operated at low liquid level to prevent agitator and vessel damage
- High temperature, and/or level

Controls developed to prevent or mitigate accident conditions are incorporated into the design. Operating conditions that have been identified that require interlocking with the melter feed involve individual components within the off-gas system that could result in overpressurization of the melter. These operating conditions include:

- Submerged bed scrubber overflow pipe to condensate vessel blockage, resulting in submerged bed scrubber flooding.
- Wet electrostatic precipitator flooding resulting in off-gas system blockage.
- Chilled water cooling coils in submerged bed scrubber leak, resulting in flooding of submerged bed scrubber and off-gas blockage.
- Off-gas fan failure.
- Loss of off-site power.

The glass former feed hoppers will include an interlock to prevent the transfer of blended glass formers to the LAW melter feed preparation vessel if the agitator is not operating.

4.1.3.2 LAW Melter Process System (LMP)

The purpose of the LMP is to convert a blended slurry of liquid LAW feed and glass former additives into molten glass. The glass is discharged from the melter into metal containers where it cools to form the ILAW.

The LAW melter system design is based on operating three joule-heated ceramic melters, identified as the LMP in a C3 environment. Key subsystems include containment, joule heating, melter feed, and glass discharge.

LAW Melters

The LAW melters have a design capacity range of approximately 10-15 metric tons of glass per 24-hour day, per melter. The LAW melter has a single internal glass chamber with a rectangular surface area. The melter is powered by three sets of electrodes mounted on opposite walls of the glass pool. The glass is discharged through either of two discharge chambers located within one of the long axis walls of the melter. The lid of the melter is composed of a layer of refractory backed by a corrosion resistant metal plate and support structure. The lid also supports the components that are submerged in the melt pool and suspended in the melter plenum. The melter is encased in an integral shielding and secondary containment enclosure.

The refractory is part of the melter containment and can be described as two separate sections. These sections are the refractory in contact with the molten glass pool, and the refractory surrounding the gas space above the glass pool, which is commonly referred to as the plenum. The glass pool refractory, used in conjunction with active cooling provided by a water jacket, will provide glass containment, thermal insulation, and electrical isolation. The plenum refractory is primarily designed to resist thermal breakdown, resist corrosion by off-gases, and resist corrosion by splashed feed and glass.

The melter shell consists of the lid and base plate as well as the structure needed to support the lid, and provides a gas barrier. The melter shell inner surface is designed to allow operation of the melter at a negative pressure with minimal air in-leakage. This inner surface will also minimize the release of melter gases and contaminants in the event of melter pressurization. A small air purge will be provided for the annular space between the cooling panels and the shell to reduce the deposition of materials. This purge will be driven by melter vacuum.

The LAW melter system has been designed to shield and contain the melter so that no additional shielding or contamination control will be required for normal operations. This has been accomplished by enclosing the melter assembly in a steel box. Shielding is provided by the entire enclosure. Access panels are provided through the external shielding. When removed, these panels will allow access to the jack-bolts, electrodes, electrode thermocouples, viewing cameras, and so forth.

The heat for the LAW melter startup is provided by temporarily installed radiant electric heaters mounted on the roof of the melter. These heaters melt glass formers sufficiently to make it ionically conductive between the melter's joule heating electrodes. When a conducting path is established, the melter is heated in a controlled manner by passing more and more current between the electrodes through the glass (a process known as joule heating). After some time, the melter reaches its operating temperature and slurry feeding can start. As water evaporates, the feed forms a "cold cap" on the surface of the melt. As more slurry is fed, molten glass is formed by vitrification of the cold cap materials into the glass melt. When the melt level rises to a predetermined level, it can be discharged into a container.

The melter plenum is maintained at a vacuum with off-gas system fans and controlled injection of air into the off-gas line near the melter exhaust. This assures containment and avoids pressurization.

Joule Heating

The joule heating system contains the melter electrodes, melter electrode power supplies, melter glass pool thermocouples, and the melter electrode control system.

The electrode configuration for each LAW melter will consist of three pairs of plate electrodes mounted parallel to each other on the long axis of the melter. The electrodes will have forced-air cooled electrode extensions. The extensions will penetrate the side of the melter below the glass level to minimize the effects of thermal expansion and to minimize the potential for sulfate corrosion. Active cooling of the extensions and the use of a water-cooling jacket will prevent glass from migrating through the refractory package adjacent to the electrode extension penetrations. Power to the electrodes will be single-phase alternating current applied across opposing electrodes. The nominal glass melt pool temperature range is 950 °C to 1,250 °C. This is measured with thermocouples in thermowells submerged into the pool at various locations. The power to the electrodes is regulated to maintain the temperature within a selected range.

Melter Feed System

Feed will be introduced to the melter as a slurry through nozzles in the melter lid. The water and volatile feed constituents in the slurry will evaporate, leaving behind a layer of material known as the cold cap. New slurry will be added at about the same rate as the cold cap dissolves, maintaining the quantity of cold cap material at a steady level. Waste feed components that remain in the cold cap will undergo chemical reactions, be converted to their respective oxides, and dissolve in the melt. Air injectors will be used to mix and agitate the molten glass. As the slurry is fed, molten glass is formed that accumulates in the glass tank. When the melt level rises to a predetermined upper limit, an air lift mechanism is actuated and glass is discharged to a container. The feed system includes the melter feed nozzles and plenum thermocouples. The melter feed nozzles are installed in the melter lid and provide a means to introduce feed slurry to the melter. The rate of feed addition to the melter determines the cold cap coverage in the melt pool, which can be controlled based on the average plenum temperature.

Glass Discharge System

Melter glass pool level measurement will be used to indicate when to start and stop glass discharge. It also provides alarms for high or low glass pool levels. Each LAW melter has two identical and independently operated glass discharge systems located adjacent to each other along side of the melter. Each of these systems includes an airlift riser, a glass pour trough, a heated discharge chamber, and other components or instruments needed to control the discharge of glass.

The glass discharge from the melter is initiated by injecting air or an inert gas at the bottom of the airlift riser. As the gas bubbles rise in the glass they will entrain glass in the riser, which is replaced by glass flowing in from the pool through the riser throat. The glass is lifted to the inlet of the trough, where the air bubbles disengage and the entrained glass flows into the trough. The glass then flows down the trough due to gravity and falls from the pour tip at the end of the trough into the container. The rate of glass discharge is controlled by adjusting the rate at which air is injected into the bottom of the riser.

Instrumentation, alarms, controls, and interlocks will be provided for the LMP to indicate or prevent the following conditions:

- Decrease or loss of melter plenum vacuum
- Plenum pressurization
- Glass temperature too high
- Electrode extension temperature too high
- Loss of melter cooling water
- Plugged feed nozzle
- Over filling of glass container

4.1.3.3 LAW Melter Off-gas System

The LAW melter off-gas system consists of the following process systems:

- LAW Primary Off-gas Process System (LOP)
- LAW Secondary Off-gas/Vessel Vent Process System (LVP)

Melter off-gas is generated from the vitrification of LAW feed in up to three joule-heated ceramic melters. The rate of generation of gases in the melter is dynamic. The melters generate off-gas resulting from decomposition, oxidation, and vaporization of feed material. Constituents of the off-gas include:

- Nitrogen oxides (NO_x) from decomposition of metal nitrates in the melter feed
- Chloride, fluoride, and sulfur as oxides, acid gases, and salts
- Cesium and technetium as the radionuclides of significance
- Entrained feed material and glass

In addition, the LAW melters generate small quantities of other volatile compounds including iodine-129, carbon-14 , tritium, and volatile organic compounds. Carbon-14 and tritium are in the form of carbon dioxide and water, respectively.

The purpose of the LAW melter off-gas system is to cool and treat the melter off-gas and vessel ventilation off-gas to a level that is protective of human health and the environment. The off-gas system must also provide a pressure confinement boundary that will control melter pressure and prevent vapor release to the cell. The design of the melter off-gas system must accommodate changes in off-gas flow from individual melters without causing the melter to pressurize and without allowing variations in the flow from one melter to impact other melters.

Separate systems are provided for the initial decontamination of off-gas from each melter. This is considered the primary off-gas treatment system. This primary off-gas system is designed to handle intermittent surges of ten times nominal flow from feed. The primary system consists of a film cooler, submerged bed scrubber, and a wet electrostatic precipitator. This system cools the off-gas and removes particulates.

In addition to the equipment listed above, the LAW melter off-gas system contains the following vessels:

- LAW caustic scrubber blowdown vessel (V22001)
- Melter submerged bed scrubber condensate vessels (V22101, V22201, V22301)

Additionally, an extra line from the melter to the submerged bed scrubber is provided in the unlikely case that the primary off-gas line plugs. This extra line is composed of a film cooler and a butterfly valve as the isolation device. As soon as the melter vacuum decreases to a set point, the butterfly valve is actuated and off-gas flow is allowed through the line to the submerged bed scrubber, thereby preventing melter pressurization. In the event that the melter surge is much higher than the system is designed to handle, a pressure relief valve acts as the pressure relief point venting the off-gas to the wet process cell.

After the wet electrostatic precipitator, the dedicated off-gas lines join plus the vessel ventilation header and are routed to the secondary off-gas treatment system. The off-gas received through the vessel ventilation system consists primarily of air, water vapor, and minor amounts of aerosols generated by the agitation or movement of vessel contents.

The secondary off-gas system (from HEPA preheater to final discharge) is designed to handle maximum sustained flowrate from the three melters assuming the three melters are operating. The system is also capable of operating effectively if only one melter is running. The secondary off-gas system consists of HEPA filters with preheater, exhauster fans, a catalytic oxidizer/reducer unit which houses the heat recovery unit (plate heat exchanger), electric preheater, the catalyst for volatile organic compound oxidation and the catalyst for NO_x reduction, and a caustic scrubber. The following sections provide descriptions of major melter off-gas treatment components.

<u>LAW Primary Off-gas Process System (LOP)</u>
The purpose of the LOP to cool the off-gas and remove aerosols generated by the melter. The primary components consist of a film cooler, submerged bed scrubber, and a wet electrostatic precipitator.

<u>Film Cooler</u>
The primary function of the film cooler is to cool the off-gas to minimize solids deposition on the off-gas piping walls. The off-gas exits the melter and is mixed with steam or steam/air

mixture in the off-gas film cooler. Each melter has a film cooler. The film cooler is a double-walled pipe designed to introduce air/steam axially along the walls of the off-gas pipe through a series of holes or slots in the inner wall.

A line connects the film cooler to the submerged bed scrubber. This line is designed to handle surges up to ten times nominal flow without causing melter pressurization. To prevent pressurization of the melter and to provide more flexibility to the main off-gas system, a standby line is provided that is identical, except for the addition of an isolation valve. In the event that the melter surge is above what the off-gas system was designed to handle, a pressure relief valve in the standby off-gas line opens allowing melter venting to the unoccupied wet process cell. Once the melter pressure is back to the desired set point, the valve closes.

Submerged Bed Scrubber

Each LAW melter has a dedicated submerged bed scrubber. After each film cooler, the off-gas enters the submerged bed scrubber column for further cooling and solids removal. The submerged bed scrubber is a passive device designed for aqueous scrubbing of entrained radioactive particulate from melter off-gas, cooling and condensation of melter vapor emissions, and interim storage of condensed fluids. It will also quench the off-gas to a desired discharge temperature through the use of coiling coils/jacket. The off-gas leaves the submerged bed scrubber in thermal equilibrium with the scrubbing solution.

The submerged bed scrubber has two off-gas inlets, one for the normal operations line and one for the standby line. The off-gas enters the submerged bed scrubber through the appropriate inlet pipe that runs down through the center of the bed to the packing support plate. The bed-retaining walls extend below the support plate creating a lower skirt, to allow the formation of a gas bubble underneath the packing. The entire bed is suspended off the floor of the submerged bed scrubber to allow the scrubbing solution to circulate freely through the bed. After formation of the gas bubble beneath the packing, the injected off-gas then bubbles up through the packed bed. The rising gas bubbles also cause the scrubbing liquid to circulate up through the packed bed, resulting in a general recirculation of the scrubbing solution. The packing breaks larger bubbles into smaller ones to increase the gas to water contacting surface, thereby increasing particulate removal and heat transfer efficiencies. The warmed scrubbing solution then flows downward outside of the packed bed through coiling coils/jacket.

To maintain a constant liquid level within the submerged bed scrubber, it will be equipped with an overflow line that allows for the continuous discharge of off-gas condensate and some scrubbed particulates to the melter submerged bed scrubber condensate vessel located next to the submerged bed scrubber column vessel. The melter submerged bed scrubber condensate vessel also is equipped with a cooling jacket. The rate of condensate discharge is determined by how much the off-gas temperature is lowered below its dew point. The condensate and some collected particulates overflow into the melter submerged bed scrubber condensate vessel. To minimize the buildup of the solids in the bottom of the submerged bed scrubber, condensate from the melter submerged bed scrubber condensate vessel will be re-circulated back to the submerged bed scrubber and injected through multiple lances to agitate and suspend solids on the submerged bed scrubber floor. The collected solids will then be pumped directly off the submerged bed scrubber vessel floor to the melter submerged bed scrubber condensate vessel. This purging and recycling process occurs simultaneously. Submerged bed scrubber condensate from the submerged bed scrubber condensate collection vessel ultimately flows to the PWD. Venting of this melter submerged bed scrubber condensate vessel is via the submerged bed scrubber into the main off-gas discharge pipe.

The scrubbed off-gas discharges through the top of the submerged bed scrubber and is routed to the wet electrostatic precipitator (one per melter) for further particulate removal.

Instrumentation, alarms, controls, and interlocks will be provided for the submerged bed scrubber to indicate or prevent the following conditions:

- High scrubber liquor temperature
- Low scrubber liquid level
- High condensate vessel liquid level
- Loss of chilled water supply
- Extremely high-pressure differential across the unit
- High density

<u>Wet Electrostatic Precipitator</u>

The submerged bed scrubber off-gas is routed to the wet electrostatic precipitator for removal of aerosols down to and including sub-micron size. Each melter system has a dedicated wet electrostatic precipitator. The off-gas enters at the top of the unit and passes through a distribution plate. The evenly distributed saturated gas then flows downward through the tubes. The tubes act as positive electrodes. Each of the tubes has a single negatively charged electrode, which runs down the center of the tube. A high voltage, direct current transformer supplies power to the electrodes. A strong electric field is generated along the electrodes giving a negative charge to the aerosols passing through the tubes. The negatively charged particles move towards the positively charged tube walls for collection. Collected particles are then washed from the tube walls along with collected mists. As the gas passes through the tubes, the first particles captured are the water droplets. As the water droplets gravity drain through the electrode tubes the collected particles are washed off, and the final condensate is collected in the wet electrostatic precipitator dished bottom area. A water spray may be used periodically to facilitate washing collected aerosols from the tubes. The tube drain and wash solution are routed to the C3/C5 effluent collection vessel.

Instrumentation, alarms, controls, and interlocks will be provided for the wet electrostatic precipitator to indicate or prevent the following conditions:

- Loss of electrical power to the unit
- High differential pressure across the unit
- Plugging of the drain line

- Loss of process water supply

Standby Off-gas Treatment System

The standby line consists of an off-gas duct from the melter to the submerged bed scrubber, a film cooler, and an isolation valve. During a melter surge (or potentially due to the off-gas duct being plugged), this valve will open rapidly, providing an alternative path for the melter off-gas to flow. With this alternative routing, pressure control on the melter plenum can be maintained. This standby off-gas duct will extend to the bottom of the submerged bed scrubber packed bed, identical to the main off-gas line. It is the same size as the main off-gas line, thus providing a doubling of flow cross-section for melter-generated gases.

The LAW melters are also equipped with a maintenance ventilation line that bypasses the submerged bed scrubber and wet electrostatic precipitator units. The purpose of this line is to provide melter ventilation during idling conditions in the unlikely event that the submerged bed scrubber or wet electrostatic precipitator requires maintenance. Prior to initiating use of the maintenance ventilation line, waste feed would be secured, and the melter placed into an idle condition. No waste feed would be fed to the melters when the maintenance ventilation line is in use.

The maintenance ventilation line may also find use during commissioning when the plant is running on non-radioactive, non-dangerous simulants. The maintenance ventilation line could also be used if maintenance was required for the melter standby or duty off-gas lines connecting the melter and the submerged bed scrubber, or the standby off-gas line actuation valve. In this case ,the standby and duty lines would be isolated, for example, by valves, spectacle flanges, or hydraulically by raising the level in the submerged bed scrubber.

Idling emissions from the melter are mainly heated air at about 1/5th to 1/10th the gas volume expected during slurry feeding. The gas will still be processed through the secondary off-gas treatment system that includes HEPA filtration, thermal catalytic oxidation, and selective catalytic reduction.

Vessel Ventilation Off-gas Treatment

The off-gas system prevents migration of waste contaminates into the process cells and potentially operating areas. It does this by maintaining the various LAW process vessels under a slight vacuum relative to the cell. The composition of the ventilation air is expected to be primarily air with slight chemical and radioactive particulate contamination.

The vessel ventilation air is combined with the melter off-gas prior to entering the secondary off-gas system HEPA filter preheater. The combined air streams are treated together in the remaining sections of the secondary off-gas treatment systems. A pressure control valve is used to regulate the pressure between the vessel ventilation off-gas system and the melter off-gas system.

LAW Secondary Off-gas/Vessel Vent Process System (LVP)
The melter off-gas stream that is treated through the primary off-gas system is combined with the vessel ventilation off-gas stream and treated through the LVP. This system removes the remaining particulate, miscellaneous acid gases, gaseous NO_x, and volatile organic compounds.

Major components in the system include:

- HEPA preheaters and filters
- Catalytic oxidizer and reducer unit
- Caustic scrubber
- LAW caustic scrubber blowdown vessel (V22001)

Descriptions of those components are provided below:

HEPA Preheaters, Filters, and Exhauster
The purpose of these HEPA filters is to provide a final protection against dispersion of radioactive particulate. This helps protect the downstream equipment from radioactive contamination. The combined off-gas stream is passed through the LAW melter off-gas HEPA preheaters. Preheating increases the gas temperature above its dew point to avoid condensation in the melter off-gas HEPA filters. Two electric heaters in series, in a common housing, are provided for redundancy. One is operational while the other one is on standby mode. The off-gas then passes through circular HEPA filters. To obtain 99.999% removal efficiency of the most penetrating particulates, two sets of filters with 99.97% removal efficiency are arranged in series. The system is composed of two parallel trains of two filters each in series. The off-gas passes through one train while the other remains available as an installed backup.

Instrumentation, alarms, controls, and interlocks will be provided for the LVP to indicate or prevent the following conditions:

- High differential pressure across a HEPA signaling to switch to the redundant unit
- Loss of preheater element
- Low pressure differential
- High radiation in the outlet stream

Catalytic Oxidizer/Reducer Unit
To remove products of incomplete combustion, volatile organics compounds, and NO_x in the off-gas stream, a catalyst skid mounted unit with a combined thermal catalytic oxidizer unit and a NO_x selective catalytic reduction unit will be used. In this unit, organic compounds are oxidized to carbon dioxide, water vapor, and possibly acid gases (depending on the halogenated volatile organic compound present in the stream). Also NO_x is reacted with ammonia to reduce it to nitrogen gas and water vapor.

The volatile organic compound catalyst column operates at a somewhat lower temperature than the NO_x catalyst; therefore it is placed at the beginning of the unit. This arrangement also prevents the formation of NO_x through the volatile organic compound catalyst from the oxidation of ammonia, which is added after the gas goes through the volatile organic compound catalyst. Further off-gas heating occurs through the volatile organic compounds catalyst as the reactions occurring are exothermic.

As the off-gas enters the unit, it travels through the heat recovery unit, which is a plate heat exchanger. The heating medium used is the exhaust from the catalytic oxidizer/reducer unit. The cool off-gas enters the cold side of the heat recovery, then passes through an electric heater to bring the temperature up to that required for the volatile organic compound catalyst to operate.

After the volatile organic compound catalyst, the off-gas enters a chamber where a gas mixture of ammonia, CO_2, and water vapor is injected through an atomized spray and allowed to mix with the off-gas. Ammonia is added so that the NO_x reduction reactions can be carried out. Two sets of NO_x catalyst modules are required to achieve the required removal efficiency of greater than 98%. The off-gas is treated through the first set of NO_x catalyst modules. After the first module, more ammonia is injected into the stream to allow further conversion in the second set. The off-gas then goes through the second catalyst module. Reduction of NO_x is also an exothermic reaction; therefore. it significantly increases the off-gas temperature. This hot off-gas then enters the hot side of the heat recovery unit to heat the incoming off-gas. The cooled off-gas stream is then directed to the caustic scrubber for iodine removal, acid gas removal, and final cooling.

Instrumentation, alarms, controls, and interlocks will be provided for the catalytic oxidizer/reducer unit to indicate or prevent the following conditions:

- High-pressure differential across each catalyst bed
- Loss of ammonia gas mixture supply to the NO_x selective catalytic reduction column
- Failure of the electric heater
- Ammonia analyzer to provide amount of ammonia slip in the outlet.
- Low off-gas temperature entering the unit
- High temperature differential across the unit
- High NO_x concentration in the unit outlet stream
- High volatile organic compound concentration in the unit outlet stream

Caustic Scrubber

The LAW melters' off-gas caustic scrubber further treats the off-gas by removing iodine and acid gases and providing final off-gas cooling. Some of the process-generated sulfur oxides are also removed in this scrubber. The off-gas stream enters the bottom of the scrubber and flows upward through a packed bed. Contaminates in the off-gas stream are absorbed into the liquid stream through interaction of the gas, liquid, and packing media. To neutralize the collected acid gases, a sodium hydroxide solution is added periodically to the caustic collection vessel. The clean off-gas is then discharged through a mist eliminator to prevent droplet carryover. The scrubbing liquid flows downward through the packing bed and drains into the caustic collection vessel. After passing through the caustic scrubber, the off-gas is released to the environment via a flue in the facility stack.

Instrumentation, alarms, controls, and interlocks will be provided for the caustic scrubber to indicate or prevent the following conditions:

- Loss of recirculation pump indicating to switch to redundant unit
- Loss of caustic supply
- Loss of process water supply
- High-pressure differential across the column
- Low scrubbing liquid level
- High scrubbing liquid level
- Loss of transfer pump
- Low pH
- High specific gravity (density)

4.1.3.4 Radioactive and Non-Radioactive Liquid Waste Disposal Systems (RLD and NLD)

The RLD receives LAW vitrification process effluents for storage and transfer.

The RLD consists of three main vessels:

- Plant wash vessel (V25001)
- LAW C3/C5 effluent collection vessel (V25002)
- Submerged bed scrubber condensate collection vessel (V25003)

The submerged bed scrubber condensate collection vessel and the plant wash vessel are located in the LAW effluent cell. The LAW C3/C5 effluent collection vessel is located below grade to provide fire protection water collection and to collect effluents from a gravity floor drain system and a pumped sump system.

Sources of effluents into the RLD are production and non-production related activities. Production effluents are radioactive liquids or slurries routinely or periodically generated by the waste treatment process. These effluents are routed directly or indirectly to the submerged bed scrubber condensate collection vessel. Liquid effluent from non-production activities, such as vessel, equipment and cell/cave washes, and sump discharges, are routed to one of three vessels, depending on the nature of the effluent. Dangerous or radioactive waste is routed to either the plant wash vessel or the LAW C3/C5 effluent collection vessel. Liquid that is not radioactive is routed to the C1/C2 floor drain/sump collection tank in the NLD.

The functional purpose of the RLD is to receive effluents for interim storage, and transfer the effluent to pretreatment plant or BOF as appropriate. In addition, mixing and sampling of the effluent may be performed in this system as required.

Plant Wash Vessel

This vessel is designed to handle the largest capacity of either the largest vessel in the LAW vitrification plant or the largest volume from the vessel/equipment wash or drain in the LAW vitrification plant. The largest volume is from the submerged bed scrubber condensate collection vessel. Effluent sources for the plant wash vessel are vessel washes and the overflow from the submerged bed scrubber condensate collection vessel. The vessel is fitted with level and temperature instrumentation. The vessel is vented into a common vessel ventilation header that drains into the LAW C3/C5 effluent collection vessel. During normal operation, the effluent characterized in the plant wash vessel is expected to be transferred to the PWD.

LAW C3/C5 Effluent Collection Vessel

This vessel and the bermed area around the vessel are designed for the probable maximum amount of fire protection water as well as hold the volume equivalent to the largest C3/C5 floor area wash. The LAW C3/C5 effluent collection vessel routinely collects liquid drained from the wet electrostatic precipitators. This vessel is designed for a two day hold-up of the wet electrostatic precipitators effluent with three melters operating under expected operating conditions. The overflow from the melter concentrate receipt vessels (V21001, V21002, V21003) is also routed to this vessel.

The vessel is fitted with level, density, and temperature instrumentation. The vessel (LAW C3/C5 Effluent Collection vessel) is vented into a common vessel ventilation header. Condensate that forms in the header drains into the LAW C3/C5 effluent collection vessel. Sampling capability is provided using a sampling leg off the pump recirculation line to an autosampler unit. Routine process-related effluent from wet electrostatic precipitator drains will be pumped from this vessel to the submerged bed scrubber condensate collection vessel, as necessary. Effluent generated from other sources will be pumped to the plant wash vessel until it reaches a predetermined level to maintain adequate capacity for fire protection water. The LAW C3/C5 effluent collection vessel is located in an enclosed C3/C5 cell area. The LAW C3/C5 effluent collection vessel overflows to a sump in the same cell. During normal operation, the effluent characterized in the LAW C3/C5 effluent collection vessel is expected to be transferred to the PWD via the submerged bed scrubber condensate collection vessel.

Submerged Bed Scrubber Condensate Collection Vessel

This vessel is designed to store submerged bed scrubber column purge effluent. The submerged bed scrubber condensate collection vessel routinely receives effluent from submerged bed scrubber column vessels and the LAW C3/C5 effluent collection vessel. It can also receive transfers from the submerged bed scrubber condensate vessels.

The vessel is fitted with level and temperature instrumentation. The vessel is vented into a common vessel ventilation header that drains into the LAW C3/C5 effluent collection vessel. Sampling capability is provided using a sampling leg off the pump recirculation line to an autosampler unit. The submerged bed scrubber condensate collection vessel overflows to the plant wash vessel. During normal operation, the effluent characterized in the submerged bed scrubber condensate collection vessel is expected to be transferred to the PWD.

Instrumentation, alarms, controls, and interlocks will be provided for the RLD to indicate or prevent the following conditions:

- Level indication: Level in the vessel is monitored for process condition and status. High-high liquid level will result in an interlock trip that will stop the incoming transfer (shuts off pump or shuts valves). High level alarm alerts operators to a high-fill condition and after a set period time may result in an interlock trip. Low level alarm alerts operator to low-fill condition. Low-low level will result in the stop of outgoing transfer.
- Temperature indication: Temperature in the vessel is monitored for process condition and status.

4.1.3.5 Radioactive Solid Waste Handling System (RWH)

The primary functions of this system will be to provide methods and packaging for the change-out of LAW melter process vessels and other miscellaneous mixed wastes.

In the event of a failure, the out-of-service melter process vessel will be prepared for export by rinsing, disconnection of the process lines, and decontamination. The vessel will be lifted out of the process cell and covered, to prevent a spread of contamination. The vessel will be placed in an approved overpack container staged for vessel receipt. Once closed and secured, the overpack, containing the vessel, will be delivered to the central waste storage area. A similar process in reverse will be used for the introduction and installation of new LAW melter process vessels.

Disposal of miscellaneous mixed waste streams created during operation will be accomplished by packaging at the point of generation. Localized collection points and disposal routes will be established at logical and optimal locations to accommodate maintenance and operations. Waste containers will be transferred to a staging areas where packages will be weighed, placarded, and decontaminated for non-fixed contamination, if needed, prior to export. The packaged waste forms will then be transferred to the central waste storage area.

4.1.3.6 ILAW Glass Container Handling

The ILAW glass container handling activities will consist of the following systems:

- LAW Container Receipt Handling System (LRH)
- LAW Container Pour Handling System (LPH)
- LAW Container Finishing Handling System (LFH)
- LAW Container Export Handling System (LEH)

The individual systems and their primary functions are described below:

LAW Container Receipt Handling System (LRH)
The LRH takes delivery of new ILAW containers and provides a means to transfer those containers to the LPH transfer bogie (wheeled cart for equipment and container transfer).

Container Receipt
After removal of the shipping overwrap and initial receiving inspection, the containers are placed on a conveyor system and transferred into the facility as needed. New containers are then logged into the tracking system.

Container Import
Prior to the need for additional containers, a final inspection and transfer takes place in the container import bay. Each new container is moved to a container inspection stand. This allows an operator to assess the upper head/lifting flange area, including the "fill" opening, and to observe the inside of the container with a light.

The rest of the container is inspected as required, then the container is placed on the import line 1 or 2 staging conveyer, and the tracking log is updated. If the container inspection fails, it is logged/tagged appropriately and set aside until it can be surveyed out of the area.

Each time a container is placed on the conveyor, an operator initiates a conveyor transfer. The transfer serves to index containers on the staging conveyor forward so there is always a container in the "pickup" position on the airlock conveyor.

Container import instrumentation, alarms, controls, and/or interlocks will be provided as follows:

- The three trap doors are interlocked with the storage cranes and bogies so that the trap doors cannot be opened unless a process crane is positioned above the trap door. Conversely, the process cranes cannot leave trap door positions unless the trap door is closed and locked.
- The trap doors are also interlocked with the bogies so that the doors can not open unless a bogie is positioned below the trap door. The interlock prevents the bogie from leaving the trap door position unless the trap door is closed.
- The storage cranes are interlocked with the hoists so that the cranes can only move with the grapple at transport height.
- The storage cranes are interlocked so that their hoists can only be lowered when signal confirms door is in open position.
- The storage cranes are interlocked to prevent them from colliding.

LAW Container Pour Handling System (LPH)
Each of the three LAW melters has two glass discharges that operate independently. Each melter discharge is provided with a glass pour cell under the melter cell and associated features for filling a container with glass. The melter will alternate filling containers in each pour cell. After a container is filled in one pour cell the melter will begin filling the next container in the other

pour cell, although containers can be filled in the same pour cell. Each pour cell is physically isolated from the others for maintenance access. The LPH handles and positions product containers for filling with LAW glass product. The major pieces of equipment include the container turntable, container elevator, transfer bogies, and monorail hoists.

Container Turntable, Container Elevator, Glass Pour Seal Head

A container turntable is provided in each pour cell for handling containers. The turntable accommodates three containers and rotates to position them at three stations: the container import/export station, the container fill station, and the container cooling station. At each container location in the turntable is a lower overpack section that locates the containers and provides support. Containers remain in the overpack during the elevating and glass filling cycle.

As containers are filled and cooled, the turntable rotates to the import/export station where container changeout occurs. Cooled, full product containers are removed from the turntable and replaced with empty containers. Once the empty container's lid has been removed, the turntable is rotated to position the empty container at the fill station. The container elevator raises the empty container and lower overpack up to the glass pour seal head for container filling. At the upper position a lock bolt is engaged to ensure elevator position during the container fill cycles.

The elevator is equipped with features to provide a weight of the product container being supported. Weight is used to verify that a container is present and that it is not full of glass. The weight must be between established minimum and maximum values for glass pouring to occur. Additionally, the weight can be used to ensure that container filling is occurring and to provide the rate of glass pouring. The elevator weight is not intended to give an accurate weight of the container; it is merely used as an indication of container presence and condition.

The glass pour seal head is the interface between the melter discharge and the product container during glass pouring. The seal head consists of a metal bellows arrangement that is connected to the melter discharge, with the other end of the bellows open for connection to product containers.

Container fill level is monitored by a thermal imaging camera. The camera provides a complete view of the diameter of and the upper two-thirds of a container. The thermal imaging camera indicates canister fill level for primary control of fill rate and pour shut off. In the event of primary level detection failure, a gamma detector activates a high-high level shutdown.

The container is filled using several pours. The pour process occurs more quickly than glass can be made in the melter, resulting in lag time between pours. Rapid pouring allows molten glass to flow out to all edges of the container. Following the final glass pour batch, the container remains in position to provide initial container cooling and containment of final glass discharges. The elevator lock is then retracted and the container lowered to the turntable. The turntable is again rotated, placing the recently filled container at the cooling/venting station. Container cooling continues while another container undergoes the fill cycle. Once cooled, the container is rotated back to the import/export station and the process is repeated.

Container Transportation

The function of the LPH is to provide product container transportation between the container transfer bogie and the melter turntable. The system transfers empty product containers from the container transfer bogie to the melter turntable, and transfers full product containers from the turntable to the transfer bogie in a manner that supports the plant throughput goals.

Concrete walls separate the pour caves from the bogie transfer tunnel. These walls have doorways large enough to allow the hoist units loaded with new or filled product containers to pass through them. The doorways are fitted with steel shield doors.

Concrete walls also separate the monorail maintenance facility from the bogie transfer tunnel. These walls have passages large enough to allow the hoist units, loaded with spare parts, to pass through them. These doorways are also fitted with steel shield doors that provide radiological shielding from sources in the drum transfer tunnel during hands-on maintenance activities in the monorail maintenance facility.

Pour cave transfer operations are conducted remotely, with only a few exceptions. Maintenance/recovery operations in the bogie transfer tunnel, such as a jammed grapple, may require hands-on intervention. Monorail hoist maintenance operations conducted in the maintenance facility are completely hands-on. Monorail hoist recovery operations can become a hands-on/remote combination depending on the failure details.

The LPH provides a buffer storage area for ILAW containers in the event down stream processing lines become backed up. Additionally, ILAW container rework that cannot be managed locally is conducted in the buffer storage area. Anticipated activities include ILAW container transfers into the buffer storage area from the container transfer bogies, container transfers within the buffer storage area, container transfer from the buffer storage area to the transfer tunnel, and container rework. The buffer storage area is adjacent to a crane maintenance facility. The buffer storage area is shielded to allow hands-on maintenance in the crane maintenance facility and drum transfer tunnel while containers are present in the buffer storage area.

The LPH drum transfer tunnel runs all the way to the east-end of the building. The buffer storage area import/export positions are located within the container transfer corridor. Concrete walls with passages for ILAW containers separate the north and south buffer storage areas and the container transfer corridor. The passages are equipped with manually operated steel shield doors to support maintenance or bogie recovery operations that might be required in this portion of the transfer tunnel. The LFH hoists operating in the lidding area above this section of the container transfer corridor transfer ILAW containers to and from the buffer storage area import/export position.

Buffer storage area container transfer operations are conducted with the use of a 10-ton bridge crane. The crane runways begin in the crane maintenance facility adjacent to the north end of the buffer storage area and extends south. The runways provide crane coverage to the crane maintenance area, the ILAW container buffer storage area, the container transfer corridor and the two container import/export positions. There are container storage positions in the north portion of the store, a minimum of five container storage positions in the south portion of the store, and one rework position, also in the south portion of the store. The rework position is located in the southeast corner of the ILAW container buffer storage area/rework area. The rework position can be fitted with a powered turntable, a pair of master-slave manipulators, and a shielded window. Directly east of the rework position, on the cold side of the buffer storage area, is a rework area operating platform that provides operator access to the master-slave manipulators and shielded window.

A crane suspended from the maintenance facility ceiling is used to support maintenance operations on the buffer storage area bridge crane. A steel shield door, along with a concrete wall rising from the floor separate the crane maintenance facility from the buffer storage area. They allow maintenance operations to be conducted while the buffer storage area contains full ILAW containers.

LAW Container Finishing Handling System (LFH)

The functions of the LFH are to verify the glass volume, determine if inert fill is required, complete closure of the ILAW container, decontaminate the exterior of the container, and to verify contamination levels before exporting the container into the container storage area. The system also has the ability to sample the solidified glass, places the glass shards in a vial, and passes these vials to the laboratory.

The filled containers are raised from the transfer tunnel into one of two finishing lines and placed on a bogie. The bogie with the container travels to the shard sampling station. A sample of the glass is taken with the glass shard sampler. Based on the calculated volume in the container, inert fill is added as needed. From there the bogie travels to the container weld station. Upon completion of container welding, the bogie travels to the decontamination area.

There are two separate decontamination areas that perform the same function. The container is then electrically grounded and decontaminated with CO_2 pellets. Produced debris is collected with a HEPA filtered exhaust system. This gas stream is then routed to the facility vent system where it is passed through the facility's HEPA filters before being discharged through the stack.

Once the container is decontaminated, it is transported to the swabbing station where it is surveyed for loose surface contamination to verify it meets the contamination requirements. The swabbing machine uses a power manipulator to maneuver the cotton swabs over the surface. The contaminated swabs are then monitored to determine gamma-beta and alpha levels for smearable contaminates. If contamination levels exceed C2 contamination criteria, the container can go through the CO_2 decontamination station or be transported into the fixative station where fixative is sprayed over the entire surface of the container and after curing the container is resurveyed. If the container meets C2 contamination criteria, the bogie moves into the monitoring/export station. As the container is transported into the monitoring/export station from the swabbing station, gamma monitoring measures the surface dose rate of the decontaminated container. If the container exceeds the contamination requirement, it is classified as an out-of-specification container.Otherwise, the dose rate is measured and is recorded with the container's records. Out-of-specification ILAW containers are routed back through the decontamination and fixative stations until the radiological contamination levels are within specification. The container is then exported to the product container storage and export.

Instrumentation, alarms, controls, and interlocks will be provided for the LRH to indicate or prevent the following conditions:

- Opening of personnel access door when container is present in the line transfer station
- Opening of personnel access door when either line transfer trap doors are open
- Opening of both line transfer trap doors at the same time
- Opening of personnel access door if airborne contamination levels are higher than design contamination classification within the line transfer station

Decontamination Station

The two decontamination stations are located within the finishing line in the LAW vitrification plant. After the ILAW container has been cooled and sealed, it is transported to the CO_2 blasting decontamination station. The container is electrically grounded during blasting operation due to static electricity generated during CO_2 blasting. Equipment items located in the decontamination station include the CO_2 gun, exhaust system, and tracking system. Most other items are located outside of the hot cell, including the CO_2 pelletizer, the transport air compressor, and the liquid CO_2 storage and delivery system.

The containers are decontaminated with CO_2 pellets. The CO_2 blasting gun contains a exhaust recovery hood to recover the effluent from the cleaning operation. Debris produced during decontamination is collected with a HEPA filtered exhaust system. This gas stream is then routed to the facility vent system where it is passed through the facility's HEPA filters before being discharged through the stack.

Once the container is decontaminated, it is transported from the decontamination station to the swabbing station.

Instrumentation, alarms, controls, and interlocks will be provided for the decontamination station to indicate or prevent the following conditions:

- Opening of welding/decontamination or decontamination/swabbing containment door during decontamination
- Opening of welding/decontamination and decontamination/swabbing containment door at the same time

Swab and Swab-Monitoring Station

At the swabbing station, containers are surveyed for loose surface contamination to verify they meet the contamination requirement. The swabbing machine uses a manipulator to maneuver the swabs over the surface. After a prescribed area is covered, the contaminated swabs are exported away from radioactive source for monitoring to determine gamma-beta and alpha levels for smearable contaminates. If contamination levels exceed C2 criteria, the container is transported back into the decontamination station for rework. If contamination levels are still above C2 criteria, the container is transported into the fixative station, located above the swabbing station. If the container meets C2 criteria, the turntable bogie moves into the monitoring/export station.

Once the container is transported into the monitoring/export station from the swabbing station, gamma monitoring measures the surface dose rate of the decontaminated container. If the container exceeds the specified dose requirement, it is classified as an out-of-specification container; otherwise, the dose rate is measured and is recorded within the container's records. The container is then exported out of the decontamination area into product container storage and export.

Instrumentation, alarms, controls, and interlocks will be provided for the swab monitoring station to indicate or prevent the following conditions:

- Personnel access when a container is present in swab monitoring station
- Opening of decontamination/swabbing or swabbing/export containment door during swabbing
- Opening of personnel access door when container is present in the swabbing station
- Opening of personnel access door if airborne contamination levels are higher than design contamination classification within the decontamination area
- Opening of personnel access door if high concentration of carbon dioxide is present within the decontamination area
- Rotation of posting turntable during swabbing
- Export of swab if radiation levels from swab are higher than design radiation classification in the operational area

Container Fixative Station

After CO_2 decontamination, if contamination levels are still above C2 criteria, the container may be transported into the fixative station, through the fixative hatch using the fixative crane. The container is placed onto the cooling/drying stand where the container is allowed to cool to the desired temperature. The fixative crane transports the container into the fixative booth and the fixative nozzle sprays a fixative over the entire container surface. After curing, the container is lowered back into the swabbing station.

Instrumentation, alarms, controls, and interlocks will be provided for the fixative unit to indicate or prevent the following conditions:

- Opening of the fixative booth containment door during the fixative process.
- Start of system when the fixative booth containment door is open.
- Start of system when personnel are present within the fixative booth.

- Start of system if ventilation system fails. If ventilation fails during the fixative process, fixative system automatically shuts down.

Container Monitoring/Export Station

Before final export to the storage area, each container received from the swabbing station is measured for surface dose rate levels. A gamma scan array is used to measure dose rate from the container. The operator will verify the process, then record the reading. If the container fails to meet the surface dose rate requirements, the container is labeled as an out-of-specification container. The container is finally exported to the product container storage and export area.

Container monitoring/export station instrumentation, alarms, controls, and/or interlocks will be provided to indicate and/or prevent the following conditions:

- Opening of the personnel access door when storage trap door is open
- Opening of the storage trap door when personnel are present within the export station

LAW Container Export Handling System (LEH)

The purpose of the LEH is to store ILAW containers prior to transferring to a Hanford Site TSD unit. This system is composed of a storage facility, export/swabbing area, truck bay, and two separate crane maintenance areas. The ILAW containers are stored in the large structure. Loading of containers onto transportation trucks occurs in the export high bay area. Containers are swabbed and loaded into transportation flasks.

Under normal operation, an ILAW container will be received from the LFH, through a trap door. The ILAW container contamination and radiation dose limits are verified to be within specifications. An operator records the container's identification and position as it is placed into the storage array.

The impact of temperature, shielding, and environmental conditions were considered in the design of the storage plant and equipment within the plant, in terms of corrosion, degradation, and accessibility to equipment. The crane area is provided with closed circuit TV cameras for in plant surveillance. A lighting system with fixtures provides the required illumination. Since personnel are excluded from entry due to radiological dose rates, remote access to each container is provided overhead.

4.1.3.7 LAW Melter Equipment Support Handling System (LSH)

The primary function of the LSH is to provide the equipment and support necessary to complete maintenance tasks on all melters and equipment in the melter gallery of the LAW vitrification plant. The primary equipment used in support of the maintenance efforts are:

- Consumable change-out boxes
- Consumable change-out boxes storage racks
- Consumable change-out boxes preparation stand

- Melter gallery process crane
- Consumable change-out boxes handler
- Lifting head
- Melter gamma gate
- Shield cover removal tool

Melter consumables will be removed through the top of the melter shielding. Melter consumable items will be those that require routine and non-routine maintenance, but provide necessary functions to continue melter operations. The routine consumable items will be bubbler assemblies. New bubbler assemblies will be shipped to the facility and will be installed into the melter. Spent bubblers will be extracted from the melter, cut up, and packaged into a drum for disposal.

Refractory thermocouples, airlifts, level detectors, feed nozzles, and film coolers will be considered non-routine and are replaced on an as-needed basis according to the appropriate procedures and with appropriate equipment.

The LSH also provides the methods, equipment, and packaging for the import of new melter bubbler assemblies and export of spent melter bubbler assemblies as well as removal of melter consumables.

4.1.3.8 LAW Vitrification Plant Ventilation

The LAW vitrification plant will be divided into four numbered zones (the C4 designation is not used) listed and defined below, with the higher number indicating greater radiological hazard potential and therefore a requirement for a greater degree of control or restriction. The zoning of the ventilation system will be based on the classifications assigned to building areas for potential radiological contamination. Zones classified as C5 are potentially the most contaminated and include the pour caves, buffer storage area, and process cells. Zones classified as C1 are uncontaminated areas.

Containment will be achieved by maintaining C5 areas at the greatest negative pressure, with airflows cascaded through engineered routes from C2 areas to C3 areas and on to the C5 areas. The cascade system, in which air passes through more than one area, will reduce the number of separate ventilation streams and hence the amount of air requiring treatment. Adherence to this concept in the design and operation of the LAW vitrification plant will ensure that the ventilation air does not become a significant source of exposure to operators, and that the air emissions do not endanger human health or the environment.

An effluent radiation monitoring system, consisting of sensors to monitor radiation in the effluent stream, or a representative sampling system is provided in the discharge header downstream of the exhaust fans. A monitoring system would consist of probe assemblies, vacuum pumps, a stack flow sensor, temperature sensor and radiation sensors. A temperature transmitter is also provided in the discharge header downstream of the exhaust fans for continuous monitoring of exhaust air temperature.

C1 Ventilation System (C1V)
C1 areas are normally occupied. C1 areas will typically consist of administrative offices, control rooms, conference rooms, locker rooms, rest rooms, and equipment rooms. C1 areas will be operated slightly pressurized relative to atmosphere and other adjacent areas.

C2 Ventilation System (C2V)
C2 areas will typically consist of non-process operating areas, equipment rooms, stores, access corridors, and plant rooms adjacent to areas with higher contamination potential. The C2V is served by dedicated air handling units and exhaust fans. Ventilation air supplied to C2 areas will be exhausted by the C2 exhaust system and cascaded into adjacent C3 areas. The sum of the volumetric flow rates exhausted by the C2 exhaust system and cascaded into adjacent C3 areas will be greater than the volumetric flow rate supplied to C2 areas. This will cause the C2 areas to maintain a nominal negative pressure relative to atmosphere. C2 exhaust will pass through one stage of HEPA filters and be discharged to the atmosphere by the exhaust fans. Supply and exhaust fans are provided with variable frequency drives.

C3 Ventilation System (C3V)
C3 areas are normally unoccupied, but allow operator access, for instance during maintenance. C3 areas will typically consist of filter plant rooms, workshops, maintenance areas, and monitoring areas. Air will generally be drawn from C2 areas and, wherever possible, cascaded through the C3 areas into C5 areas, or alternatively exhausted from the C3 areas by the C3 exhaust system. In general, air cascaded into the C3 areas will be from adjacent C2/C3 subchange rooms. When sufficient air cannot be cascaded into C3 areas, a dedicated C2 supply equipped with appropriate backflow prevention will be used. C3 exhaust will pass through one stage of HEPA filters and be discharged to the atmosphere by the exhaust fans. C3 exhaust fans are provided with variable frequency drives.

C5 Ventilation System (C5V)
In general, air cascaded into the C5 areas will be from adjacent C3 areas. If there is a requirement for engineered duct entries through the C3 boundary, they will be protected by backflow HEPA filters, with penetrations through the boundary sealed.

The C5 areas in the LAW vitrification plant will be composed of the following:

- Pour caves
- Drum transfer tunnel
- Buffer storage area
- C3/C5 Drain tank room
- Process cells
- Finishing line

Air will be cascaded into the C5 areas and exhausted by the C5 exhaust system. Engineered duct entries (air in-bleeds) through the C5 confinement boundary will be protected by backflow HEPA filter isolation dampers. C5 exhaust will pass through two stages of HEPA filters and be discharged to the atmosphere by the exhaust fans. C5 exhaust fans are provided with variable frequency drives.

4.1.4 HLW Vitrification Plant

The HLW vitrification plant will consist of several process systems designed to perform the following functions:

- Store pretreated HLW slurry
- Convert blended HLW slurry and glass formers into glass
- Treat melter off-gas
- Handle IHLW containers
- Store IHLW containers
- Provide supporting equipment in the melter cave
- Handle miscellaneous waste
- Ventilate the HLW vitrification plant

Figure 4A-1 presents the simplified flow figure for the WTP, Figure 4A-4 presents the simplified flow of primary process systems, and the following figures found in Appendix 4A provide additional detail for the HLW vitrification plant:

- Simplified process flow figures for process information
- Typical system figures depicting common features for each regulated system
- Simplified general arrangement figures showing locations of equipment and associated tanks
- Waste management area figures showing plant locations to be permitted
- Contamination/radiation area boundary figures showing contamination/radiation zones throughout the plant

Descriptions of the HLW vitrification process, melter off-gas treatment systems, and IHLW glass container handling systems are provided in the following sections.

4.1.4.1 HLW Melter Feed

The HLW melter feed consists of the following:

- HLW Cave Receipt Process System (HCP)
- HLW Melter Feed Process System (HFP)

The primary function of this system is to receive HLW feed slurry from the pretreatment plant, mix glass formers with HLW feed to form a uniform blend, and provide a blended feed to the HLW melter. An analysis of the waste determines a glass additive formulation for the conversion of the waste to glass. The glass additives specified in the formulation are weighed and mixed with the waste.

The HLW melter feed system contains the following equipment:

- Two concentrate receipt vessels (V31001 and V31002)
- Glass former feed hopper
- Feed preparation vessel (V31101)
- HLW melter feed vessel (V31102)

The two HLW concentrate receipt vessels, located in a wet process cell, receive HLW concentrate from the pretreatment plant. Process control samples are collected from these vessels and analyzed to determine the glass former formulation. Typically, the concentrate receipt vessels are operated in opposite cycles, where one vessel is filled and sampled while the other is being emptied. After completion of sample analysis, a batch of waste is transferred to the feed preparation vessel for blending with glass formers from the glass former feed hopper. The glass former feed hopper receives blended glass formers and reductant (such as silica, boric acid, calcium silicate, ferric oxide, lithium carbonate, and sucrose) from the HLW glass former feed room. After the blending, the glass formers are gravity-fed into the feed preparation vessel, where the blended glass formers are mixed with the HLW concentrate to form a uniform slurry. The slurry is then fed to the HLW melter feed vessel and then to the HLW Melter Process System (HMP).

Instrumentation, alarms, controls, and interlocks will be provided for the HCP and HFP to indicate or prevent the following conditions:

- Vessel overflow
- Loss of vessel integrity
- Loss of cooling water flow
- Loss of agitator function
- Agitator not operated at low liquid level to prevent agitator and/or vessel damage
- High or low pressure, temperature, and/or level

Controls developed to prevent or mitigate accident conditions are incorporated into the design. Operating conditions that have been identified that require interlocking with the melter feed involve individual components within the off-gas system that could result in overpressurization of the melter. These operating conditions include:

- Failure of standby off-gas duct butterfly valve to open in response to melter surge

- Insufficient airflow to film cooler or blockage of film cooler

4.1.4.2 HLW Melter Process System (HMP)

The primary functions of this system are to convert blended waste feed and glass formers into molten glass, deliver molten glass to HLW canisters, fill the canisters with molten glass waste, and monitor and control glass waste level during waste filling.

The HMP includes the HLW melter, two pour spouts, and primary and secondary canister level detection systems. The melter, pour spout, and level detection will be remotely operated in a C5/R5 cell. There will be no personnel access to this cell after hot processing of the HLW feed stream begins.

HLW Melter

The HLW melter, located in the melter cell near the south wall, is a rectangular tank with an outer steel casing. The tank is lined with refractory material designed to withstand corrosion by molten glass. The steel casing for the melter area is provided with water cooling to maintain a thermal gradient in the bricks for corrosion control, prevent migration of glass through the bricks, and reduce heat load to the process cell. The lid of the HLW melter will be sealed to the melter shell in order to provide gas containment. The lid will provide a support structure through which sub-components can be mounted. Penetrations, primarily on the lid, through the outer shell are sealed by appropriate fittings that allow remote removal and replacement.

The feed is introduced to the melter through a tube that ends at the top of the feed nozzle. The feed nozzle is insulated to prevent drying the feed before it reaches the melter. Water flushes will be used to clear the feed lines as necessary. Feed will be introduced to the melter as a slurry through nozzles in the melter lid. The water and volatile feed constituents in the slurry will evaporate, leaving behind a layer of material known as the cold cap. New slurry will be added at about the same rate as the cold cap dissolves, maintaining the quantity of cold cap material at a steady level. Waste feed components that remain in the cold cap will undergo chemical reactions, be converted to their respective oxides, and dissolve in the melt. Air injectors may be used to mix and agitate the molten glass. The slurry is fed at a constant rate to each melter. As the slurry is fed, molten glass is formed that accumulates in the glass tank. When the melt level rises to a predetermined upper limit, it is discharged to a container. The feed system includes the melter feed nozzles and plenum thermocouples. The melter feed nozzles are installed in the melter lid and provide a means to introduce feed slurry to the melter. Each feed nozzle will be individually supplied from a slurry pump. The rate of feed addition to the melter determines the cold cap coverage in the melt pool, and can be controlled based on the average plenum temperature. The glass level in the melter is maintained between the top of the electrodes and below the upper edge of the glass contact refractory blocks.

The melter includes three important regions: the glass pool, two discharge chambers, and a plenum just above the glass pool. Melter pool level measurement is used throughout melter operations in conjunction with alarms for high or low glass pool levels. Each discharge chamber is a heavily insulated box on the south side of the melter, housing the discharge trough and a connection flange for the pour spout assembly. The plenum is lined with refractory to withstand hot corrosive gases, thermal shock, and slurried waste splatter. The power to the electrodes is regulated by the PCS to maintain the temperature at the set point value.

The heat for the HLW melter startup is provided by temporarily installed radiant electric heaters mounted on the lid of the melter. These heaters melt the glass formers sufficiently to make it ionically conductive between the melter's joule heating electrodes. When a conducting path is established, the melter is heated in a controlled manner by passing more and more current between the electrodes through the glass (a process known as joule heating). After some time the melter reaches its operating temperature (generally in the range of 950 °C to 1,250 °C) and slurry feeding can start. As the slurry is fed, molten glass is formed by vitrification of the cold cap materials into the glass melt. When the melt level rises to a predetermined level, it can be discharged into a container.

The gas produced during melting is mainly steam and contains volatile components and airborne matter that require removal prior to discharge to the atmosphere. This off-gas is diluted by air from four sources; inadvertent air in-leakage through the melter lid and discharge port, instrumentation and sparging, film cooler air, and air added to control the melter vacuum. The melter plenum is maintained at a vacuum with off-gas system blowers and control injection of air into the off-gas line near the melter exhaust. This assures containment and avoids pressurization. This vacuum is sensed at a location near the plenum where blockage and feed splatter is unlikely. The sensed vacuum is used to drive a control valve that regulates the draft in the melter exhaust line.

The glass level in the melter is maintained between the top of the upper electrodes and below the upper edge of the tank blocks. The level is determined directly by two bubbler tubes that indicate density and glass depth. Thermocouples housed in thermowells that penetrate the cold cap and are immersed in the molten glass also indicate molten glass level. Level measurement is used throughout melter operations in conjunction with alarms for high or low glass pool levels.

<u>Glass Discharge System</u>

Discharge is achieved by transferring glass from the bottom of the melt pool up through a riser and out of the melter through a side discharge chamber. Under each of the two discharge chambers there is a pour spout that connects the melter discharge chamber to the respective HLW canister.

With the pour spout assembly retracted and its slide gate closed, a canister is moved into position under the pour spout. The pour spout slide gate seals the opening, preventing large quantities of air from entering the melter and preventing glass drips from falling into the canister tunnel. When a canister is in position under the pour spout, the pour spout is lowered into position by extending the pour spout bellows. The slide gate is then opened and glass drips or fibers collected on the slide gate, while the pour spout assembly was in standby, will be scraped off into the canister. After verification of the slide gate and pour spout positions, the canister is ready to receive glass. During pouring operations, a remote camera is used to view the pour stream within the pour spout assembly.

The canister level detector monitors the glass fill height and is used to control the molten glass level within the HLW canister, as it is poured from the melter. Once the canister is filled, pouring is terminated and the canister is allowed to cool. After cooling, the slide gate closes and the pour spout lifts away from the canister, compressing the pour spout bellow. After verification of the slide gate and pour spout positions, the canister is transported to the lidding assembly.

As the canister is transported to the lidding assembly, a standby canister is placed under the pour spout and the pour spout is lowered into position by extending the pour spout bellows to create a metal-to-metal seal with the standby canister. The slide gate is then opened and glass drips or fibers collected on the slide gate while the pour spout assembly was in standby will be scraped off into the standby canister. When a new canister is ready to be placed under the pour spout, the process is repeated again.

Level Detection

The purpose of each canister level detection system is to monitor the molten glass level within the HLW canister and to prevent canister overfilling. During glass pour, the level detection system is used to monitor the glass level to assure the canister is filled to the desired level. The level detection system also will be able to monitor the rate at which the glass level is rising in the canister. There is a primary and a secondary monitoring system, which is consistent with standard vessel level control. A primary system that operates through the PCS is used for normal operations, and a secondary "hard-wired" system is used to back up the primary system and automatically shut down the fill before the overflow limit is reached. The primary level detection system is a thermal imaging system that provides continuous level monitoring over the entire canister. In the event that the primary thermal imaging system malfunctions, the backup discrete point radiation detection system shall indicate a filled canister.

During pour, the level detection system will display a thermal image on a monitor in the central control room and will utilize a serial connection to interface with the PCS for indication and control purposes. The imaging software will be used to continuously monitor the level of glass in the canister and will provide an output of the glass level to control loops in the PCS. A high-level condition will be indicated by the PCS, which will initiate alarms and/or control sequences to control the melter pour. The infrared image will be available through the plant closed circuit television system. The control system will be able to store the level of the glass in a canister between batch pours when the temperature in the canister could be cooled down sufficiently to prevent the thermal imaging system from detecting the glass level. The level is reset to zero with each new canister. The control system will also be used to monitor the average temperature of the glass near the top of the pour. If the temperature is lower than a set point value, an alarm will be initiated by the PCS.

Another function of the system is to detect the rate at which the glass level is rising in the canister. This gives an indication of deviation between expected normal pour rates. Deviation could indicate a malfunction of the glass discharge system, and an alarm would be initiated.

In the event that the primary thermal imaging system malfunctions, the backup discrete point radiation detection system shall prevent a canister overfill. This system is designed only to detect a discrete high glass level, producing a contact closure when the high level is sensed. When the high level has been reached, the system will automatically shut down the melter gas lift which, in turn, will stop the glass pour. The system is limited to discrete levels of glass fill, not continuous monitoring.

Instrumentation, alarms, controls, and interlocks will be provided for the HMP to indicate or prevent the following conditions:

- The slide gate cannot be opened without verification that the pour spout is attached to a canister
- The melter cannot pour glass without verification that the slide gate is open
- The melter cannot pour without verification that the bogie is present
- The melter cannot pour without verification that the canister is present
- The melter cannot pour if the canister is greater than 95% full

4.1.4.3 Melter Off-gas Treatment Process System (HOP)

The HLW Melter Off-gas Treatment Process System (HOP) consists of the following subsystems:

- HLW primary off-gas system
- HLW vessel vent system
- HLW secondary off-gas system

Melter off-gas is generated from the vitrification of HLW in the joule-heated ceramic melter. The rate of generation of gases in the melter is dynamic and not steady state. The melter generates off-gas resulting from decomposition, oxidation, and vaporization of feed material. Constituents of the off-gas include:

- Nitrogen oxides (NO_x) from decomposition of metal nitrates in the melter feed
- Chloride, fluoride, and sulfur as oxides, acid gases, and salts
- Dangerous waste metals
- Dangerous waste organics
- Radionuclide particulates and aerosols

In addition, the HLW melter generates small quantities of other volatile compounds including iodine-129, carbon-14, tritium, and volatile organic compounds. The carbon-14 and tritium emissions are in the form of CO_2 and water respectively.

The purpose of the HOP is to cool and treat the melter off-gas and vessel ventilation off-gas to a level that is protective of human health and the environment. The off-gas system must also provide a pressure confinement boundary that will control melter pressure and prevent vapor release to the plant. The design of the melter off-gas system must accommodate changes in off-gas flow from the melter without causing the melter to pressurize.

Initial decontamination of off-gas from the melter is provided by the primary off-gas treatment system. This primary off-gas system is designed to handle intermittent surges of seven times steam flow and three times non-condensable flow from feed. The primary system consists of a film cooler, submerged bed scrubber, a wet electrostatic precipitator, and a high efficiency mist eliminator. This system cools the off-gas and removes particulates.

Additionally, an extra line from the melter to the submerged bed scrubber is provided in the unlikely case that the primary off-gas line plugs. This extra line includes a valve as the isolation device. As soon as the melter vacuum decreases to a set point, the valve is actuated and off-gas flow is allowed through the line to the submerged bed scrubber, thereby preventing melter pressurization. In the event that the melter surge is much higher than the system is designed to handle, a pressure relief valve acts as the pressure relief point venting the off-gas to the melter cell.

The vessel ventilation header joins the primary off-gas system after the wet electrostatic precipitator. After the high efficiency mist eliminator, the off-gas is routed to the secondary off-gas treatment system. The off-gas received through the vessel ventilation system consists primarily of air, water vapor, and minor amounts of aerosols generated by the agitation or movement of vessel contents.

The secondary off-gas system (after the HEPA filters to final discharge) is designed to handle maximum sustained flowrate from the melter. The secondary off-gas system consists of the following major components:

- Heat recovery unit
- Exhauster fans (two sets)
- Catalytic oxidizer/reducer unit
- Electric preheater
- Iodine absorption column
- Submerged bed scrubber condensate collection vessel (V32101)

The following sections provide descriptions of major melter off-gas treatment components:

Primary Melter Off-gas Treatment System
The purpose of the primary off-gas treatment system is to cool the melter off-gas and to remove off-gas aerosols generated by the melter and from the vessel ventilation air. This treatment

system consists of a film cooler, a submerged bed scrubber, a wet electrostatic precipitator, a high efficiency mist eliminator, an electric heater, and high efficiency particulate air filters.

Film Cooler
The function of the film cooler is to cool the off-gas below the glass sticking temperature to minimize solids deposition on the off-gas piping walls. The off-gas exits the melter and is mixed with air in the off-gas film cooler. Each melter has a single film cooler. The film cooler is a double-walled pipe designed to introduce injected gas axially along the walls of the off-gas pipe through a series of holes or slots in the inner wall.

A mechanical reamer may be mounted on the film cooler to periodically remove solids build-up on the inner film cooler wall. The reaming device (wire brush or drill) would be periodically inserted into the film cooler for mechanical solids removal.

Submerged Bed Scrubber
The off-gas from the HLW melter film cooler is further cooled and treated by a submerged bed scrubber. The off-gas enters the submerged bed scrubber column for further cooling and solids removal. The submerged bed scrubber is a passive device designed for aqueous scrubbing of entrained radioactive particulate from melter off-gas, cooling and condensation of melter vapor emissions, and interim storage of condensed fluids. It will also quench the off-gas to a desired discharge temperature through the use of coiling coils/jacket. The off-gas leaves the submerged bed scrubber in thermal equilibrium with the scrubbing solution.

The submerged bed scrubber has one off-gas inlet. The off-gas enters the submerged bed scrubber through the inlet pipe that runs down through the center of the bed to the packing support plate. The bed-retaining walls extend below the support plate creating a lower skirt, to allow the formation of a gas bubble underneath the packing. The entire bed is suspended off the floor of the submerged bed scrubber to allow the scrubbing solution to circulate freely through the bed. After formation of the gas bubble beneath the packing, the injected off-gas then bubbles up through the packed bed. The rising gas bubbles also cause the scrubbing liquid to circulate up through the packed bed, resulting in a general recirculation of the scrubbing solution. The packing breaks larger bubbles into smaller ones to increase the gas to water contacting surface, thereby increasing particulate removal and heat transfer efficiencies. The warmed scrubbing solution then flows downward outside of the packed bed through coiling coils/jacket.

To maintain a constant liquid level within the submerged bed scrubber, it will be equipped with an overflow line that allows for the continuous discharge of off-gas condensate and some scrubbed particulates to the submerged bed scrubber condensate collection vessel located next to the submerged bed scrubber column vessel. The submerged bed scrubber condensate collection vessel also is equipped with a cooling jacket. The rate of condensate discharge is determined by how much the off-gas temperature is lowered below its dew point. The condensate and some collected particulates overflow into the submerged bed scrubber condensate collection vessel. To minimize the buildup of the solids in the bottom of the submerged bed scrubber, condensate from the submerged bed scrubber condensate collection vessel will be re-circulated back to the submerged bed scrubber and injected through multiple lances to agitate and suspend solids on the submerged bed scrubber vessel floor. The collected solids will then be pumped directly off the submerged bed scrubber vessel floor to the condensate storage vessel. This purging and recycling process occurs simultaneously. Venting of this condensate receiver vessel is via the submerged bed scrubber into the main off-gas discharge pipe.

The scrubbed off-gas discharges through the top of the submerged bed scrubber and is routed to the wet electrostatic precipitator for further particulate removal.

Wet Electrostatic Precipitator

The submerged bed scrubber off-gas is routed to the wet electrostatic precipitator for removal of aerosols down to and including sub-micron size. The off-gas enters at the top of the unit and may pass through a distribution plate. The evenly distributed saturated gas then flows downward through the tubes. The tubes act as positive electrodes. Each of these tubes has a single negatively charged electrode, which runs down the centerline of each tube. A high voltage, direct current transformer supplies the power to the electrodes. A strong electric field generated along the electrodes giving a negative charge to the aerosols. The negatively charged particles move toward the positively charged tube walls for collection. Collected particles are then washed from the tube walls along with collected mists. As the gas passes through the tubes, the first particles captured are the water droplets. As the water droplets gravity drain through the electrode tubes the collected particles are washed off and the final condensate is collected in the wet electrostatic precipitator dished bottom area. A water spray may be used periodically to facilitate washing collected aerosols from the tubes. The tube drain and wash solution are routed to a collection vessel.

High Efficiency Mist Eliminator

Further removal of radioactive aerosols is accomplished using the high efficiency mist eliminator. The high efficiency mist eliminators also reduce the dust-loading rate on the HEPA filters. A high efficiency mist eliminator is essentially a high efficiency demister that has a removal efficiency of greater than 99 % for aerosols down to the sub-micron size. As the off-gas passes through the high efficiency mist eliminator, the liquid droplets and other aerosols within the off-gas interact with high efficiency mist eliminator filaments. As the aerosols contact the filaments they adhere to the filaments surface by surface tension. As the droplets agglomerate and grow, they eventually acquire enough mass to fall by gravity to the bottom of the unit, thus overriding the original surface tension, friction with the filaments, and the gas velocity. These collected droplets are assumed to contain the majority of the off-gas radioactivity and will be collected in the bottom of the high efficiency mist eliminator. The collected condensate will gravity drain into the submerged bed scrubber condensate collection vessel. As the condensate flows down through the filter bed, a washing action is generated that will help wash collected solids from the filter elements. However, some solids may accumulate in the bed over time, causing the pressure drop across the filter to increase. When the pressure drop across the high efficiency mist eliminator reaches a predefined level, it is washed with process water to facilitate removal of accumulated solids. Some insoluble solids may remain, and their accumulation will eventually lead to the replacement of the high efficiency mist eliminator filter elements.

HEPA Preheaters, Filters and Exhauster

Next, the off-gas is heated using an electric preheater to a temperature above the gas streams dew point and then passed through dual set of HEPA filters to provide high efficiency submicron removal. The off-gas is heated to avoid condensation in the HEPA filters. The HEPA filters provide a combined particulate removal efficiency greater than 99.999 %. When the differential pressure drop across the filters becomes too high, they will be remotely changed out. The system is comprised of two parallel heater/HEPA filter trains. The off-gas passes through one train while the other remains available as an installed backup.

Maintenance Ventilation Bypass

A maintenance bypass will also be installed, allowing the melter off-gas to bypass the submerged bed scrubber and the wet electrostatic precipitator. This bypass would only be used after the HLW melter has been idled and the cold cap eliminated. The bypass line would feed gas into the secondary off-gas system for HEPA filtration and other gas cleaning steps.

Vessel Ventilation Off-gas Treatment

The vessel ventilation off-gas system prevents migration of waste contaminates into the process cells and potentially operating areas. It does this by maintaining the various HLW process vessels under a slight vacuum relative to the cell. The composition of the ventilation air is expected to be primarily air with slight chemical and radioactive particulate contamination.

The vessel ventilation air is combined with the melter off-gas prior to entering the primary off-gas system high efficiency mist eliminators. The combined air streams are treated together in the remaining sections of the primary and secondary off-gas treatment systems. A pressure control valve is used to regulate the pressure between the vessel ventilation off-gas system and the melter off-gas system.

HLW Pulse Ventilation System

Gaseous emissions are produced by pulse jet mixers and reverse flow diverters that are used to mix and move wastes in the HLW vitrification plant. The exhausts from reverse flow diverters and pulse jet mixers throughout the HLW vitrification plant are collected in the pulse ventilation system headers. This exhaust is potentially contaminated with aerosols and particulates. Electric preheaters eliminate liquid aerosols and reduce the relative humidity of the gas stream, as necessary, before it encounters the system HEPA filters. The gas is passed through HEPA filters to remove particulates that may be present. When the differential pressure drop or radiation level across the filters becomes too high, they will be remotely changed out.

Secondary Off-gas Treatment System

The combined primary off-gas stream and vessel ventilation off-gas stream is discharged to the secondary off-gas treatment system. The secondary off-gas system will treat the combined off-gas to a level protective of human health and the environment. Specifically, the secondary off-gas treatment system will remove radioactive iodine, volatile organic compounds, and acid gases (HCl, HF, NO_x), as required, to meet the facilities air discharge requirements. The secondary off-gas treatment system consists of a organic thermal catalytic oxidizer unit, NO_x selective catalytic reduction unit, and a silver mordenite column.

Catalytic Oxidizer/Reducer Unit

To remove products of incomplete combustion, volatile organics compounds, and NO_x in the off-gas stream, a catalyst skid mounted unit with a combined thermal catalytic oxidizer unit and a NO_x selective catalytic reduction unit will be used. In this unit, organic compounds are oxidized to carbon dioxide, water vapor, and possibly acid gases (depending on the halogenated volatile organic compound present in the stream). Also NO_x is reacted with ammonia to reduce it to nitrogen gas and water vapor.

The volatile organic compound catalyst column operates at a somewhat lower temperature than the NO_x catalyst; therefore, it is placed at the beginning of the unit. This arrangement also prevents the formation of NO_x through the volatile organic compound catalyst from the oxidation of ammonia, which is added after the gas goes through the volatile organic compound catalyst. Further off-gas heating occurs through the volatile organic compounds catalyst as the reactions occurring are exothermic.

As the off-gas enters the unit, it travels through the heat recovery unit, which is a plate heat exchanger. The heating medium used is the exhaust from the catalytic oxidizer/reducer unit. The cool off-gas enters the cold side of the heat recovery, then passes through an electric heater to bring the temperature up to that required for the volatile organic compound catalyst to operate.

After the volatile organic compound catalyst, the off-gas enters a chamber where gaseous ammonia is injected through an atomized spray and allowed to mix with the off-gas. Ammonia is added so that the NO_x reduction reactions can be carried out. Reduction of NO_x is also an exothermic reaction therefore it significantly increases the off-gas temperature. This hot off-gas then enters the hot side of the heat recovery unit to heat the incoming off-gas. The cooled off-gas stream is then directed to the silver mordenite column for iodine and acid gas removal.

Silver Mordenite Column

The silver mordenite column is present to remove halogens such as radioactive iodine, fluorine, and chlorine from the melter off-gas. Silver mordenite is an absorbent in the form of cylindrical pellets contained in cartridges. The absorbent is expected to lose effectiveness over time and will require replacement. Halogens react with the silver in the bed and are trapped within the matrix. Loading begins at the front of the silver mordenite beds and progressively load the silver through the column until breakthrough is reached at the end of the column. Absorption reactions occur within a reaction zone (or mass transfer zone) that varies in length depending on the temperature of the bed and the gas velocity through the bed. The reaction zone length within a silver mordenite bed is readily apparent through the use of a transparent column since the there is a color change as the reaction progress. The silver mordenite pellets will change color from white, to yellow, and finally a purple color, once the silver is consumed. The column structure is similar to that in a carbon bed absorber. The “column” is not a tank-like structure, but is instead a bank of cartridges through which the gas stream is directed. The absorbent cartridges allow for manual removal and replacement when required or after a predetermined life span, and are sized to fit into standard waste containers for disposal.

4.1.4.4 Radioactive Liquid Waste Disposal System (RLD)

The primary functions of the RLD are to receive, store, and transfer various effluents from different HLW treatment systems for collection and handling.

The RLD contains four vessels located in the HLW vitrification plant wet process cell:

- Acidic waste vessel (V35002)
- Plant wash and drains vessel (V35003)
- Decontamination effluent collection vessel (V35009)
- Off-gas drains collection vessel (V35038)

The RLD receives radioactive effluent from the Melter Off-gas Treatment Process System (HOP), the HLW Canister Decontamination Handling System (HDH), and periodic plant and vessel washes within the HLW vitrification plant.

These effluents include the following: submerged bed scrubber purge, wet electrostatic precipitator drain, high efficiency mist eliminator drain, canister decontamination waste, various plant and vessel washes, sump wastes, and miscellaneous radioactive drains, including vessel vent, bulge, and cabinet drains.

The functional purpose of the RLD is to handle liquid waste for interim storage and transfer to pretreatment facilities where the waste is either recycled to the process or sent to the LERF/ETF. Various operations such as neutralization, mixing, and sampling of the waste are performed by these systems as required.

<u>Acidic Waste Vessel</u>
This vessel collects liquid from the submerged bed scrubber and the submerged bed scrubber condensate collection vessel. The collected liquid waste consists of submerged bed scrubber purge, wet electrostatic precipitator drain, and high efficiency mist eliminator drain. Sampling will be performed via an automated sample system to characterize the liquid waste. The contents are transferred to the HLW effluent transfer vessel (V12002) in pretreatment.

<u>Plant Wash and Drains Vessel</u>
This vessel collects washes from vessels, sumps and plant washes within the HLW vitrification plant, including wash water from cell walls, equipment exterior surfaces, stainless steel cladding, and bulges. This vessel also collects the C3 area fire water. Sampling will be performed via an automated sample system to characterize the liquid waste. The contents are transferred to the HLW effluent transfer vessel (V12002) in pretreatment.

<u>Decontamination Effluent Collection Vessel</u>
This vessel receives liquid waste from waste neutralization vessel (V33002). Sampling will be performed via an auto sampler to characterize the liquid waste. The contents are transferred to the HLW effluent transfer vessel (V12002) in pretreatment.

<u>Off-gas Drains Collection Vessel</u>
This vessel receives condensate from the HOP ducts downstream from the high efficiency mist eliminator during off-normal operation. The contents are transferred to the plant wash and drains vessel in the HLW vitrification plant.

Instrumentation, alarms, controls, and interlocks will be provided for the RLD to indicate or prevent the following conditions:

- Level indication: level in the vessel is monitored for process condition and status. High level alarm alerts operators to high-fill condition. High-high level will result in the stop of the incoming transfer. Low level alarm alerts operator to low-fill condition. Low-low level will result in the stop of outgoing transfer.
- Temperature indication: temperature in the vessel is monitored for process condition and status.
- Density indication: density is monitored for process condition and status. The density is also used to determine the liquid level.
- Pressure indicator: vessel vacuum is monitored to assure contaminated vapor containment. The pressure is also used to determine the liquid level.
- Prevent receiving waste when the vessel is at high-high liquid level.
- The pump and mixer are cut-off at low-low liquid level.
- The pump will stop transfer if the destination vessels (in pretreatment or within the HLW vitrification plant) reach high-high liquid level.

4.1.4.5 IHLW Glass Canister Handling

The IHLW glass canister handling will consist of the following systems:

- HLW Canister Receipt Handling System (HRH)
- HLW Canister Pour handling System (HPH)
- HLW Canister Decontamination Handling System (HDH)
- HLW Canister Export Handling System (HEH)

The individual systems and their primary functions are described below:

<u>HLW Canister Receipt Handling System (HRH)</u>
The primary function of this system is to import clean canisters into the facility. The HRH consists of the equipment, controls and interlocks required for importing a clean canister into the plant. This system consists of the canister import truck bay, the import bulge, the canister import tunnel and the canister transfer interface into the handling cave. These areas are located on the south side of the plant.

The HRH begins at a truck bay where canisters are first brought within the HLW vitrification plant. An import bulge is located in the truck bay on the north wall and on the south side of the import tunnel. The bulge is intended to provide a separate air space between the C1 truck bay, and the C3 import tunnel during canister import.

An overhead crane, stationed in the truck bay, will unload shipping canisters from the transport truck. The shipping canisters will be placed in the staging area where receiving personnel will inspect the canister packaging for shipping damage. The crane will then remove an individual IHLW canister from the shipping canister and place it on the inspection/rotation table. The lid will be removed, and both the canister and the lid will be inspected for cleanliness, damage, and compliance with new product canister specifications. The canister identification number is assigned and results of inspection are recorded. Each canister will have a unique identification number that will be entered into the plant tracking system to allow tracking of the canister throughout the plant.

After the canister inspection, the import bulge roller shutter door will be opened and the table will rotate the canister into the vertical position. This is required before introduction into the canister handling cave because all process sequences are designed to handle a vertical canister. The canister lid will be replaced and the overhead monorail hoist and grapple will grab and support the canister while being released from the table. The monorail will lift and transfer the canister into the import bulge. The canister will either be set in the import buffer racks or placed in the import bogie. When the canister is transferred to the import tunnel, the sealed hatch is opened and the canister is lowered into the import bogie below. Once the canister is loaded into the bogie, the grapple is released and withdrawn and the hatch is closed. The bogie is transferred to the canister handling cave. The canister handling cave's shielded hatch is then opened and the canister handling cave crane raises the canister into the canister handling cave. The hatch is closed and the canister is taken to the canister handling cave buffer storage area rack. The canister identification number will be logged in the plant information network as being entered into the process.

Instrumentation, alarms, controls, and/or interlocks will be provided for the HRH as follows:

- Sealed hatch will be interlocked with the shielded hatch
- Personal access door to import tunnel will be interlocked with gamma monitors
- Shielded hatch will be interlocked with roller shutter door preventing back flow of C3 air into truck bay
- Prevent rotation/inspection table from rotating when roller shutter door is closed
- The import tunnel sealed door is interlocked with the import hatch

<u>HLW Canister Pour Handling System (HPH)</u>
The primary functions of this system are as follows:

- Transport IHLW canisters between the canister handling cave and melter pour station

- Provide a transfer router for secondary waste and equipment for decontamination and maintenance
- Transport IHLW empty and filled canisters to interfacing process systems
- Provide cooling buffer storage prior to welding
- Provide lag storage prior to canister decontamination
- Staging empty canisters for filling and full canisters for cooling
- Provide buffer storage of canisters
- Crane decontamination and maintenance
- Export of consumables
- Prepare IHLW canisters for welding
- Weld canister lids
- Provide glass shard sampling
- Inspect canisters
- Rework defective welds

This section focuses primarily on Pour Tunnel 1; however, Pour Tunnel 2 will be utilized to support a second melter, as necessary. The equipment for Pour Tunnel 2 will be similar to that provided for Pour Tunnel 1 but will be installed later to support the second melter.

<u>Pour Tunnels</u>
The pour tunnels are located south of the melter caves and run in the north-south direction. The bogie and rails extend further under the melter cave under the melter allowing a standby bogie to be positioned under the melter when the process bogie is in the pour position. The rails will be isolated from the melter cave with steel contamination control barriers. The bogie decontamination areas are located south of the melter caves. Viewing windows and master-slave manipulators are provided for each bogie.

When a canister is required for filling, it is taken out of the buffer rack in the canister handling cave using the canister handling cave crane and transferred above the appropriate pour tunnel hatch. The hatch is opened and the canister handling cave crane loads the empty canister into the pour tunnel bogie. The grapple is released and raised and the hatch is closed. The bogie travels north to the lidding device. At the lidding device, the primary bogie moves up to the standby bogie and latches onto it. The primary bogie is then in position with the lid removed. The standby bogie is shunted along the track until the primary bogie is in position under the pour spout. The primary bogie is then in position, the pour spout is lowered onto the canister flange, and the canister is filled with glass. Canister filling is controlled and monitored by the canister level detection system.

After completion of filling, the canister remains at the pour spout for approximately one hour to allow a “skin” to form over the glass which provides a seal to prevent additional off-gassing. The pour spout is then retracted and the primary bogie is unlocked, and moved back. This sequence also moves the stand-by bogie back under the pour spout. The filled canister is allowed to cool prior to removal from the pour tunnel. The primary bogie is then unlatched from the standby bogie and moved south in the pour tunnel until it is beneath the canister handling cave hatch. The hatch is opened, the canister handling cave crane removes the full canister, and the hatch is closed. The filled canister is then cooled in cooling racks in preparation for welding the lid in place.

Canister Transport

IHLW canisters are transported within the canister handling cave by means of an overhead crane. A standby crane is available in the event of the primary overhead crane failure. Viewing windows and camera are provided for viewing of equipment and operations within the cave area. Integrated networks of programmable logic controllers, which form part of the PCS, are used to control the mechanical handling.

The clean canister is transferred from the HRH to the HPH through the canister import tunnel hatch. The hatch opens and the handling cave crane raises the canister into the canister handling cave. The hatch is closed and the canister is taken to the buffer storage area racks. When a canister is required for filling, it is taken out of the buffer rack using the canister handling cave crane and transferred above the appropriate pour tunnel hatch. The hatch is opened and the canister is lowered into the pour tunnel bogie below. The grapple is released and raised and the hatch is closed. After the canister is filled with glass, the crane located above the hatch transfers the filled canister to the buffer/cooling rack where it is allowed to cool. After cooling, a crane transfers the canister for welding, sampling, and/or rework. The canister is lowered into the welding station table and the grapple released from the canister. After the welding station operations, the crane transfers the canister back to the cooling racks or to the decontamination system rinse bogie, via the decontamination hatch.

The canister handling cave is classified as a C5 area; therefore, most activities in the handling cave will be handled remotely. This will be accomplished with viewing windows, cameras, and overhead cranes. Windows are strategically located above the transfer hatches for viewing the canisters as they are raised and lowered. The crane decontamination area is located on the west end of the canister handling cave. The decontamination area is classified as a C5/C3 area. The crane maintenance area is located west of the crane decontamination area. The crane maintenance area is classified as a C3 area.

Canister Weld, Glass Sampling & Rework

The canister lid welding, glass sampling, canister inspections, and rework will be performed at one of two welding tables located along one wall in the canister handling cave. Only one table will be set up with equipment initially, but the second table may be outfitted identically to the first table to support a second melter at a later date. Each table will be set next to a shield window. Master-slave manipulators, closed circuit television, and lights will be provided when they are required for operations.

After the canister is cooled in the canister handling cave, the overhead crane moves the canister from the cooling rack into a port on the welding table. The canister is weighed and confirmed to be below the maximum allowable weight. While the canister is being lowered, cameras inspect the outside of the canister. Typically, glass waste residue is not expected on the exterior of the canister. However, prior to welding the lid on the canister, the canister is inspected. If glass is found on the canister, the glass will be removed using a needle descaler manually operated with the master-slave manipulator. A vacuum system will be used to capture the removed glass and prevent the spread of debris. The canister is then checked to confirm that its temperature is within the allowable range for welding. This is done using a thermocouple at the station. Then the lid is removed using a lid lifter, and required inspections, such as glass fill height or foreign debris inside the canister, are performed. Glass samples are collected using an master-slave manipulator-operated glass sampling tool that uses a vacuum to draw shards of glass from the top surface. These shards are then transferred into sample vials and transferred to the laboratory using a transfer system.

The lid is placed on the canister and welding is performed using an automated welder. The welding torch has an arc voltage controlled head and the ability to remotely control the torch angle, travel speed, and travel direction. The welding parameters are recorded in the plant tracking system. The finished weld is visually inspected using in-cave inspection cameras. Rejected welds may be repaired by re-melting the weld, mechanically removing the weld and re-welding, or welding a secondary lid over the primary lid. Metal dust and slag resulting from rework will be removed using a localized HEPA vacuum to minimize the spread of contamination. The sealed canister is transferred to the HLW Canister Decontamination Handling System (HDH).

Instrumentation, alarms, controls, and interlocks will be provided for the IHLW canister handling system to indicate or prevent the following conditions:

- Zone controls will be employed on the HPH crane to prevent the canister from impacting the welding station during canister transfers. An interlock on the crane will prevent the crane from coming into position over the canister port in the table unless the weld station carriage is positioned out of the way for this movement.
- Carriages will not move when the equipment mounted on the frame is deployed or in operation.
- The crane decontamination shield door is interlocked with the crane maintenance shield door to prevent both doors from being open concurrently.
- The shielded door in the crane maintenance area is interlocked with the crane maintenance shield door. The door is also interlocked with a gamma monitor to prevent opening when a dose is present.
- Process cranes are interlocked such that their hoists can only be lowered at designated positions in automatic mode, and if over hatches, when signal confirms door is in open position.
- Process cranes are interlocked with the hoists such that the cranes can only move with the grapple at transport height.

- The process cranes are interlocked such that they cannot attempt to enter the crane decontamination area unless the crane decontamination shield door is open.
- The bogie maintenance shield door is interlocked with the shielded personnel access door to ensure that personnel do not enter the bogie maintenance area when the bogie maintenance shield door is open.
- Radiation monitoring equipment is interlocked to the shielded personnel access door to ensure no personnel are able to access the maintenance area if a radiation/contamination source above prescribed limits is present.
- The bogie sleeve detector is interlocked to the bogie maintenance shield door to ensure the sleeve is removed from the bogie before the bogie enters the maintenance area.
- An interlock with ensure that the canister lid has been removed before glass filling can take place.

<u>HLW Canister Decontamination Handling System (HDH)</u>
The primary function of this system is to decontaminate the IHLW canisters, swab and monitor IHLW canisters, and decontaminate the HDH equipment.

The HDH includes the process and equipment to perform the cerium nitrate canister decontamination process, surface swabbing, and swab monitoring process. The IHLW canister will be managed above floor level in the decontamination cave and below floor level in the rinse and transfer tunnels either on a bogie or suspended by crane.

The HDH consists of a canister rinse tunnel, decontamination station, swabbing and monitoring station and canister transfer tunnel. The decontamination station is located in front of a viewing window. The decontamination system consists of two stations: the decontamination station which is located in-cave (canister decontamination vessel, waste neutralization vessel, and two breakpots to waste neutralization tank) and a mixing station (including nitric acid addition tank, cerium addition tank, and hydrogen peroxide addition pot) which is located out-cave. Vertical separation between the stations facilitates gravity flow of process solutions from the mixing station to the decontamination vessel. Beneath the canister decontamination cave is a canister rinse tunnel and a canister storage transfer tunnel. The canister rinse tunnel includes a bogie decontamination and maintenance area and houses the canister rinse bogie which transfers the canister from the canister handling cave to the canister decontamination cave while performing a prewash at an intermediate station. The canister storage transfer tunnel houses the canister storage transfer bogie which transfers the decontaminated canisters from the canister decontamination cave to the canister storage cave.

A filled, cooled, and welded IHLW canister is initially transported to the HDH via a crane located in the canister handling cave. The IHLW canister is loaded onto the canister rinse bogie, and washed in a sealed area using low-pressure demineralized water to remove loose contamination. This water wash is performed in a container mounted on the canister rinse bogie, which travels from below the canister handling cave to below the canister decontamination cave. After the water wash, the canister is transferred by a crane to the decontamination vessel for further decontamination by chemically etching a thin layer of stainless steel from the canister surface, using cerium ion in a dilute nitric acid. The canister is then washed with nitric acid, followed by a second washing with de-ionized water. The canister remains in the vessel to dry, while the decontamination fluids are pumped into a vessel to which hydrogen peroxide is added to neutralize remaining cerium ion. Following neutralization, the fluid is transferred to the plant waste stream and it can be recycled back into the HLW melter via pretreatment. The decontaminated canister is transported by overhead crane to the swabbing area.

After decontamination and drying, the canister is swabbed using an automated power manipulator. If the contamination is below acceptable limits, the IHLW canister is placed into a canister storage transfer bogie located below the canister decontamination cave floor, and transported to the HLW Canister Export Handling System (HEH). IHLW canisters that exceed the contamination limits are returned to the decontamination and swabbing station for further processing. Swabbing and monitoring results are recorded.

Instrumentation, alarms, controls, and interlocks will be provided for the HDH to indicate or prevent the following conditions:

- Interlocks will be provided on bogie decontamination/maintenance area shield door to protect plant personnel from radiation and contamination exposure.
- Interlocks will be provided on crane maintenance area shield door to protect plant personnel from contamination exposure.

<u>HLW Canister Export Handling System (HEH)</u>
The primary functions of this system are to provide storage of the IHLW canisters in storage racks, transfer the IHLW canisters into the canister storage cave, load the IHLW canisters onto product casks, evaluate product casks for contamination, and load IHLW product casks into transport vehicles. The HEH consists of a canister storage cave, a cask handling tunnel, a cask loading area, and a truck bay.

The decontaminated IHLW canisters are transferred to the canister storage cave from the HDH using a bogie and an overhead crane and placed in the canister storage racks. When a IHLW canister is ready for exporting to an appropriate Hanford Site TSD unit, a dedicated transport vehicle is dispatched to the IHLW truck bay. The empty product cask is removed from the vehicle and placed on a cask transfer bogie located in the cask handling tunnel. The bogie transfers the cask to a lid lifting station where the lid is removed, and then to a canister receiving station. The IHLW canister is visually inspected in the canister storage cave and its identification confirmed. After the inspection information is recorded, the canister is lifted by overhead crane and placed into the product cask. The bogie then returns the cask to the lid lifting station where the lid is replaced. The product cask is then transferred to the export station where the cask is lifted by an overhead crane and placed on the transport vehicle. Swab samples are taken, and when the cask exterior is verified to be below the acceptable radioactive contamination level, the cask is transported to a Hanford Site storage facility.

Closed circuit television cameras will provide general viewing of the canisters and the storage area. Descriptions of inspections of IHLW canister storage areas are included in Chapter 6 of this application. An IHLW canister tracking system will retain required information such as the IHLW identification number, weight, and dimensions of the IHLW canisters.

Instrumentation, alarms, controls, and interlocks will be provided for the HEH to indicate or prevent the following conditions:

- Interlocks to prevent the canister storage cave import hatch and the canister storage cave export hatch from being open at the same time
- Gamma monitoring and keyed interlocks to prevent the cask export hatch from opening when high radiation levels exist
- Interlock to prevent cask handling crane movements into the truck bay unless the truck bay inner roller shutter door is open
- Interlock to prevent the truck bay inner roller shutter door closing if the hoist/cask is in danger zone
- Interlock to prevent cask handling bogie travel to canister storage cave export hatch unless the cask lid is removed and the cask export hatch is closed
- Interlock to prevent the canister storage cave export hatch from being open at the same time as the cask export hatch
- Interlock to prevent hoist-lowering cask onto the cask handling bogie unless the cask export hatch is open and the cask handling bogie is in place and locked in position with the bogie location bolt
- Interlock to prevent hoist-lowering canister into cask unless the canister storage cave export hatch is open and the cask handling bogie is in place and locked in position with the bogie location bolt
- Gamma detectors/interlock to prevent cask handling bogie travel to the cask export hatch unless the cask lid is properly installed
- Interlock to prevent both truck bay "exit" and "entrance" (external) roller shutter doors from being open at the same time
- Interlock to prevent the truck bay inner roller shutter door from being open at the same time as either of the "exit" or "entrance" roller shutter doors

4.1.4.6 HLW Melter Cave Mechanical Systems

HLW melter cave mechanical systems will consist of the following individual systems:

- HLW Melter Cave Support Handling System (HSH)
- HLW Filter Handling (HFH)
- HLW Melter Handling System (HMH)
- Radioactive Solid Waste Handling System (RWH)

The individual systems and their primary functions are described below:

HLW Melter Cave Support Handling System (HSH)

The primary function of this system is to provide remotely operated equipment to perform these support activities in the melter cave:

- Melter maintenance and replacement
- Melter component and consumable maintenance and replacement
- Melter component and consumable dismantling, sorting and loading
- Equipment decontamination and hands-on maintenance

The melter cave will contain the melter, melter feed preparation and feed vessels, and certain off-gas system components. Overhead cranes, hoists, master-slave and power manipulators will be the primary equipment used to carry out various replacement, size reduction, and packaging tasks. Auxiliary tools will include impact wrenches, nut-runners, and hydraulic shears.

In addition, the HSH will provide the means to dismantle and reduce the size of spent melter components or consumables for export out of the cave in waste containers. Various size reduction tools will be used to cut down the equipment. The waste will be placed on a sorting table for screening and segregation prior to packaging and export.

Melter replacement will generally be preceded by an alternate glass removal step. Lid heaters will keep the glass pool at the desired temperature ranges. Air and vacuum lines will be inserted to draw the molten glass into an attached canister. The failed melter will be disconnected and prepared for transport out of the cave.

A consumable bucket, equipped with interchangeable lid cutouts called templates, will be used to import and export melter consumables. HLW Melter Feed Process System vessels will be organized such that power manipulators can disconnect connections and prepare failed vessels and components for export. Components of the HOP found in this cave will also be organized for similar activities.

The HSH will provide a crane decontamination room above the C3/C5 airlock, to allow for decontamination of equipment before hands-on maintenance in the crane maintenance area. In the decontamination room, the crane and equipment will be decontaminated with a demineralized high pressure wash water spray. Non-organic detergents or acid solvents may also be used, if needed. Wash water will be collected by a sump.

HLW Filter Handling System (HFH)

The primary function of this system is to provide the equipment and controls necessary for:

- Filtration of process area exhaust air
- Service, repair, and replacement of filters

- Size reduction and packaging of spent filters

The HFH will house the equipment that provides C5 filtration for the HLW vitrification plant. Located within the filter cave will be the HVAC HEPA filter banks, HLW melter off-gas HEPA preheaters, HLW melter off-gas HEPA filters, and ancillary equipment and instrumentation.

Spent equipment and consumables will be moved into and out of the filter cave using bogies and cranes. Power manipulators and hoists will facilitate the movement of equipment within the filter cave. Shield doors will form a radiological barrier between the cave and the overhead crane maintenance area. The filter cave will be equipped with closed circuit television.

A power manipulator will be used for interfacing directly with filter lids, dampers, and elements during replacement of HEPA filters. Spent filters will be placed into a disposal basket at the filter compactor. A two-stage compact telescopic cylinder compresses the filter into the basket sized to fit inside a waste container on top of a drum transport bogie. Once the basket is full, it will be loaded into the drum and transported to the RWH. Spray wash nozzles above the crane's locked position and a spray cabinet for the power manipulator will be used to ensure that the equipment is maintained in an uncontaminated state.

<u>HLW Melter Handling System (HMH)</u>
The primary function of this system will be to provide the equipment and controls necessary to:

- Transport new melter units into the HLW melter cave
- Remove spent melter units from the HLW melter cave
- Decontaminate and monitor the spent melter overpacks

A multi-axle transporter will be used to move a new overpacked HLW melter from the melter assembly building to the HLW vitrification plant loading dock. The overpacked melter will be offloaded, transferred through the rollup doors to the melter cave airlock, transferred through the airlock, and docked to the melter cave shield door. After opening the shield and overpack doors, the melter will be moved out of its overpack and installed in the melter cave.

The process of removing a spent HLW melter from the cave and loading it back into its overpack is the reverse of the installation. The overpack will provide a shielded disposal canister for the spent melter. After the outside surfaces of the overpack have been checked for radiological contamination and decontaminated as required, the spent melter and its overpack will be moved through the melter airlock and placed on the transporter, to be moved out of the HLW vitrification plant through the rollup doors.

Decontamination of the overpack in the C3/C5 airlock, before it is exported, will be done manually using moist cloths. Water spray will also be provided as a contingency. The airlock will have a sump to collect decontamination water.

Prior to disposal, the melter will be stored in the HLW out-of-service melter storage facility. If a melter fails to meet the receiving TSD waste acceptance criteria, it will be stored until the HLW vitrification plant operating conditions are suitable for the failed melter to be returned to the melter cave for further decontamination, treatment, repackaging, and/or other process to enable the melter to meet the receiving TSD's waste acceptance criteria.

Radioactive Solid Waste Handling System (RWH)

The primary functions of this system are to:

- Provide containers for removal of miscellaneous solid waste from the HLW melter cave and filter cave
- Transport filled and empty waste containers
- Provide external radiological monitoring of waste containers
- Decontaminate waste containers as required
- Assay waste containers to determine radiological inventory
- Supply and load waste containers into transport casks
- Transfer casks to the central waste storage facility

At both the filter cave and the melter cave, the drum will be positioned under the filter cave/melter cave export well and the drum transfer bogie will be locked into position. The containment between the filter cave/melter cave, and the drum transfer tunnel will be maintained by an engineered air-gap between the top of the drum and the underside of the export well. A loaded basket will then be lowered into the drum, using the filter cave/melter cave handling equipment. The drum will then be lowered and transferred to the drum lidding station, where the outer lid will be replaced and crimped onto the drum.

One of the main functions of the RWH is to transport waste containers between the plant operating area and the swabbing and monitoring area within the RWH. Prior to transporting to the central waste storage area, the sealed drums will be swabbed for contamination along their bottom, sides, and lid interface. Viewing windows will be positioned to allow for the evaluation of the swabbing process. The swabs will be monitored for radiological contamination in an external glovebox. If surface contamination exceeds the accepted limits, the drum will be repeatedly vacuum-cleaned, swabbed, and washed with wet swabs until the radiological limits have been met. Drums will be transported by means of an overhead bridge crane and drum grapple. The drums will be lowered through the swabbing and monitoring system floor hatch into an open transport cask. The cask lid will be replaced and the cask will be monitored for gamma radiation shine paths before it is transferred to the import/export area by means of the cask transfer bogie. The cask will then be transferred to the truck bay by an overhead crane for shipment to the central waste storage area.

4.1.4.7 HLW Vitrification Plant Ventilation

The HLW vitrification plant will be divided into four numbered zones listed and defined below, with the higher number indicating greater radiological hazard potential and, therefore, a requirement for a greater degree of control or restriction. The zoning of the ventilation system will be based on the classifications assigned to building areas for potential radiological contamination. Zones classified as C5 are potentially the most contaminated and include the pour caves, buffer storage area, and process cells. Zones classified as C1 are uncontaminated areas.

Containment will be achieved by maintaining C5 areas at the greatest negative pressure, with airflows cascaded through engineered routes from C2 areas to C3 areas and on to the C5 areas. The cascade system, in which air passes through more than one area, will reduce the number of separate ventilation streams and hence, the amount of air requiring treatment. Adherence to this concept in the design and operation of the HLW vitrification plant will ensure that the plant air does not become a significant source of exposure to operators, and that the air emissions do not endanger human health or the environment.

An effluent radiation monitoring system, consisting of sensors to monitor radiation in the effluent stream, or a representative sampling system is provided in the discharge header downstream of the exhaust fans. A monitoring system would consist of probe assemblies, vacuum pumps, a stack flow sensor, temperature sensor and radiation sensors. A temperature transmitter is also provided in the discharge header downstream of the exhaust fans for continuous monitoring of exhaust air temperature.

<u>C1 Ventilation System (C1V)</u>
C1 areas will typically consist of offices, workshops, control rooms, and equipment rooms. They will be slightly pressurized if they are adjacent to areas with higher contamination potential, to eliminate backflow from those areas.

<u>C2 Ventilation System (C2V)</u>
C2 areas will typically consist of operating areas, equipment rooms, stores, access corridors, and plant rooms adjacent to areas with higher contamination potential. The C2V is served by dedicated exhaust fans. Air supplied to the C2 areas which is not cascaded to the C3 or C5 areas is discharged to the atmosphere by the exhaust fans. Both exhaust fans are provided with variable frequency drives. A manual isolation damper is provided upstream of each exhaust fan and a pneumatically actuated isolation damper is provided downstream. Each damper is provided with local/remote position monitoring.

<u>C3 Ventilation System (C3V)</u>
C3 areas are normally unoccupied, but allow operator access, for instance during maintenance. C3 areas will typically consist of filter plant rooms, workshops, maintenance areas, and monitoring areas. Air will generally be drawn from C2 areas and, wherever possible, cascaded through the C3 areas into C5 areas, or alternatively exhausted from the C3 areas by the C3 exhaust system. In general, air cascaded into the C3 areas will be from adjacent C2/C3 subchange rooms. When sufficient air cannot be cascaded into C3 areas, a dedicated C2 supply equipped with appropriate backflow prevention will be used.

C5 Ventilation System (C5V)
In general, air cascaded into the C5 areas will be from adjacent C3 areas. If there is a requirement for engineered duct entries through the C3 boundary, they will be protected by backflow HEPA filters, with penetrations through the boundary sealed.

The C5 areas in the HLW vitrification plant will be comprised of the following:

- Pour caves
- Transfer tunnel
- Buffer storage area
- C3/C5 drain tank room
- Process cells

Air will be cascaded into the C5 areas and exhausted by the C5 exhaust system. Engineered duct entries (air in-bleeds) through the C5 confinement boundary will be protected by backflow HEPA filter isolation dampers, with penetrations through the boundary sealed.

4.1.5 Analytical Laboratory

The analytical laboratory will be comprised of the high activity and low activity laboratories. Sample conveyance systems will automatically transport samples from the other process plants to the analytical laboratory. High activity samples will be managed in a hot cell area that will contain hot cells dedicated to specific analytical techniques or functions. The hot cell exhaust will be handled by the C5 ventilation system. Low activity samples will be managed in low activity laboratories. Each laboratory will have a specific function and analytical equipment. Fume hoods within these laboratories will be handled by the C3 ventilation system. The ventilation will be HEPA filtered and exhausted through the analytical laboratory stack.

Figure 4A-107 provides a the layout of the main floor of the analytical laboratory. In this layout, the following attributes are outlined:

- Workstations have been defined as required by the sampling and analysis plan for WTP process control and waste form qualification
- Capability to provide the limited process technology is provided in both the hot cell area and the radiological laboratory rooms for specialized sample evaluations
- Redundancy of major instrumentation has been accommodated
- Contamination control has been incorporated for reliability of laboratory service to the WTP processes
- Receipt and processing of DST system samples are accommodated in both capability and capacity
- An administrative area has been provided to support a fully operational, stand-alone facility

Figure 4A-108 provides a layout of the second floor. The second floor of the analytical laboratory provides for analyses and segregation of the radioactive samples from the low and non-radioactive samples. Reliability is assured that contamination of the low-active samples will not be problematic. There are no entrances directly between the main floor and the second floor without egress through the change rooms. Samples are introduced through an outside door directly to the second floor. Prepared sample aliquots for radionuclide quantitation are transferred by dumbwaiter directly to the appropriate counting room.

Room is available to process essential materials and prepare reagents for laboratory performance monitoring using standards and laboratory reagents. The second floor also provides ample office space for the professional staff, including a conference room and training room space, data package assembly and oversight, and support staff for the laboratory information management system.

The hot cell area includes a row of hot cells that support WTP Process Technology as shown in Figure 4A-109. Two below-grade counting rooms are shown in Figure 4A-110 near the below-grade tank system. The counting rooms are located below grade to make use of the shielding from the earth surrounding the room to reduce the background in the rooms as much as possible. One counting room is dedicated to the effluent level, radionuclide quantitation, and the second is dedicated to high radionuclide concentration samples. Dumbwaiters deliver the prepared sample aliquots from the high activity laboratories to the high activity counting room, and the prepared mounts from effluent samples to the low activity counting room. Radionuclide detection levels necessary to manifest the retention basin water for disposal at treated the LERF/ETF can be met in this facility. Most instrumentation is duplicated in each counting room; however, certain specialized instrumentation is provided uniquely where applicable.

The wall separating the two counting rooms provides shielding from the gamma emissions from high activity samples entered into the high activity room. Wastes generated in the analytical laboratory will be recycled through the pretreatment process or packaged and transferred to the central waste storage facility awaiting disposal.

The following figures found in Appendix 4A provide additional detail for the analytical laboratory:

- Simplified process flow figure for process information
- Typical system figure depicting common features for the regulated tank system
- Simplified general arrangement figures showing locations of equipment and tanks
- Contamination/radiation area boundary figures showing contamination/radiation zones throughout the lab

Descriptions of the analytical laboratory process and mechanical handling systems are provided in the following sections.

Autosampling Systems

The sampling will be performed by a computer-controlled autosampler system. A clean sample vial is pneumatically transferred to the autosampler unit, where the vial is mounted on a sample needle through the vial septum. The other end of the sample needle penetrates a sample loop that is circulated by a reverse flow diverter. A venturi effect on the sample needle creates a slight negative pressure in the sample vial, as the diverter circulates the waste through the sample loop. When the flow in the sample loop slows to a stop, the venturi effect ceases and waste is drawn into the sample vial. The vial is withdrawn from the needle after the appropriate sample volume is collected, placed in a carrier and pneumatically transferred to a shielded sampling cabinet in the laboratory for sample preparation and analysis.

High Activity Laboratory

The high activity laboratory will consist of a main sample receipt area and several hot cells. Descriptions of these areas are summarized below:

High Activity Laboratory Receipt Facility

The high activity laboratory receipt facility will remove the sample bottle from the sample carrier and moves it into the high activity laboratory hot cells. The laboratory receipt facility will be equipped with a gamma monitor to detect residual radiation.

Hot Cells

The high activity samples will be handled in hot cells. The hot cells will include equipment and facilities to perform activities such as the following:

- Sample receipt
- Total Organic analysis
- Glass sample preparation
- Toxicity Characteristic Leaching Procedure (TCLP) analysis
- Gamma analysis
- General physical properties analysis

Low Activity Laboratory

The low activity samples will be handled in the low activity laboratories. The main activities that will be performed in these laboratories are listed below:

- Sample dispensing
- X-ray spectrometry (XRF) and X-ray diffraction (XRD) analysis
- Total organic analysis
- General chemistry analysis with differential scanning calorimeter, cold vapor atomic absorption, cyanide analysis, ion chromatograph
- Atomic Emission Spectroscopy (AES)
- Gamma and alpha analysis

<u>Sampling Methods</u>
Methods and equipment selected for use will meet the applicable requirements of the specific SW-846 or other appropriate sampling or analysis procedures. Modifications of a procedure, other than sample size, will be requested in accordance with applicable requirements.

<u>Cascade Ventilation System for Analytical Laboratory Hot Cells</u>
A primary factor in the design of the ventilation system for the WTP is the need to isolate the sources of radiation, and radiological and dangerous waste contamination, to protect human health and the environment during normal and abnormal operating conditions. Barriers or barrier systems, including ventilation systems, will contain and minimize the release of radionuclides and contaminants. The ventilation systems are designed to conform to stringent nuclear facility ventilation standards, and fugitive emissions from the pretreatment and vitrification facilities will be minimized.

The pretreatment plant, LAW vitrification plant, HLW vitrification plant, and analytical laboratory will be divided into five numbered zones, with the higher number indicating greater contamination potential and, therefore, a requirement for a greater degree of control or restriction. A separate zoning system for the ventilation systems will be based on the system for classifying building areas for potential contamination. Zones classified as C5 will have the potential for the greatest contamination and will include the pretreatment cells, melter cells, and glass pouring and cooling cells. C5 zones will be operated remotely. Zones classified as C1 will be those areas that have no risk of contamination, such as equipment rooms and offices.

Confinement will be achieved by maintaining the greatest negative pressure for areas with greatest contamination (e.g., C5 areas), with airflows cascade from least to most contaminated areas (e.g., C1 or C2 to C5 areas). The principle of a cascade system, in which air passes through more than one area, effectively reduces the number of separate ventilation streams and hence the amount of air requiring treatment. Adherence to this principle in the design and operation of the WTP will ensure that the plant will not become a significant source of radiological or dangerous waste exposure to operators, or emissions to the environment.

4.1.6 Balance of Facilities (BOF)

The BOF will include, by definition, support systems and utilities required for the waste treatment processes within the pretreatment, LAW vitrification, HLW vitrification, and Laboratory. Specific operational facilities will be established to provide the BOF support systems and utilities. These will include, but will not be limited to, heating and cooling, process steam, process ventilation, chilled water, primary and secondary power supplies, and compressed air. Local control panels will be provided in each building, with the main control room located at the pretreatment plant.

Unlike the waste treatment process areas, the BOF support systems and utilities will not manage dangerous waste, therefore this section is provided for information purposes only.

4.1.6.1 Instrument Service Air (ISA) and Plant Service Air (PSA) Systems

The process air system will provide a continuous supply of compressed air for the process tanks and vessels in the pretreatment, LAW and HLW vitrification plants, and other miscellaneous uses. The instrument air system will receive air from the process air system, and further dry the air through dessicant dryers. Process air and instrument air that have entered the process plants will not return to the BOF.

Critical users (those who would be compromised or damaged by loss of process air) will include the following systems, components, or controls:

- Instrument air system
- The ultrafiltration system
- Melter support systems

The compressors will be located in the chiller/compressor building.

4.1.6.2 Plant Cooling Water System (PCW)

The cooling water system will supply cool water to heat exchangers supporting process equipment coolers. Cooling water will remove heat from plant equipment coolers in the process buildings and return the heated water to a multi-cell mechanical draft-cooling tower where the heat will be released. The cooling water system is designed to remain uncontaminated by chemical and radiological constituents. The cooling water will be chemically treated and filtered to promote system operability and extend service life to 40 years.

4.1.6.3 Low-Pressure Steam System (LPS)

The low-pressure steam system operates at approximately 85 psig at 330 °F. This system will provide a continuous supply of steam for various users in the pretreatment, LAW, and HLW vitrification plants. The process plants' main use of steam will be for tank heating and for the evaporation process.

The low-pressure steam system will be supplied from the high-pressure steam system through pressure-reducing stations. The steam condensate and feed system will collect condensate from the low-pressure steam users, monitor for radioactivity, and return it to the steam plant for re-use.

4.1.6.4 High-Pressure Steam System (HPS)

The system will provide a continuous supply of high-pressure (approximately 135 psig at 360 °F) steam for the ejectors in the pretreatment, LAW, and HLW vitrification plants. Once this steam enters the process buildings there will be no return streams to the BOF.

The steam plant will house the boilers that produce the steam.

4.1.6.5 Demineralized Water System (DIW)

This system will distribute demineralized water to various plant locations, after drawing it off the process water system (described below). Once the demineralized water enters the process buildings it will not return to the BOF.

The system can deliver demineralized water for the following processes:

- Fresh ion exchange resin addition
- Wash rings
- Decontamination
- Melters
- Laboratory

4.1.6.6 Process Service Water System (PSW)

This system will supply raw water to end users. This water will serve processes such as off-gas treatment and process reagent systems. Once the process water enters the process buildings it will not return to the BOF.

4.1.6.7 Chilled Water System (CWS)

This system will supply chilled water to various HVAC unit cooling coils and plant equipment coolers for the WTP. The system is a closed loop and will provide approximately 65 psi at the junction with process buildings. Chilled water will be used in various systems throughout the WTP. The chilled water system is designed to remain uncontaminated by chemical and radiological constituents. The chilled water will be chemically treated to promote system operability and extend the service life to 40 years.

4.2 WASTE MANAGEMENT UNITS

The following sections provide information on the waste management units at the WTP:

- Containers, including management and storage areas – Section 4.2.1
- Tanks systems for storage and treatment – Section 4.2.2
- Miscellaneous units – Section 4.2.3
- Containment buildings – Section 4.2.4

4.2.1 Containers [D-1]

This section of the application identifies the containers and container management practices that will be followed at the WTP. The term “container” is used as defined in WAC 173-303-040. Note that in the DWPA, terms other than containers may be used, such as canisters, boxes, bins, flasks, casks, and overpacks.

The container storage areas located in the LAW vitrification plant are:

- ILAW buffer container storage area (immobilized glass)
- ILAW container storage area (immobilized glass)
- LAW container storage area (secondary waste)

The container storage areas located in the HLW vitrification plant are:

- IHLW container storage area (immobilized glass)
- HLW container storage area 1 (secondary waste)
- HLW container storage area 2 (secondary waste)
- HLW container storage area 3 (secondary waste)

The container storage areas (secondary waste) located within the BOF are:

- Central waste storage facility
- Non-radioactive dangerous waste storage area
- LAW out-of-service melter storage facility
- HLW out-of-service melter storage facility

Container storage area dimensions at the WTP are summarized in Table 4-2.

The following sections address waste management containers:

- Description of Containers – Section 4.2.1.1
- Container Management Practices – Section 4.2.1.2
- Container Labeling – Section 4.2.1.3
- Containment Requirements for Storing Waste – Section 4.2.1.4
- Prevention of Ignitable, Reactive, and Incompatible Wastes in Containers – Section 4.2.1.5

4.2.1.1 Description of Containers [D-1a]

Four types of waste will be managed in containers:

- IHLW (immobilized glass)
- ILAW (immobilized glass)
- Miscellaneous mixed waste (secondary waste)
- Miscellaneous non-radioactive dangerous waste (secondary waste)

The waste form dictates the type of containers used for waste management. The following paragraphs describe these four types of containers which are managed by the WTP.

Immobilized Glass Waste

The immobilized glass waste is a mixed waste that will be managed in containers specially designed to remain stable during receipt of glass waste, and which are capable of remote handling. Schematics of the example IHLW containers and ILAW containers are presented in Figures 4A-118 and 4A-119.

The LAW immobilized glass waste containers will be approximately 90 inches high and 48 inches in diameter, with a wall thickness of approximately 0.187 inches and a nominal capacity of 90 cubic feet. ILAW containers will be constructed of steel.

The IHLW canisters will be approximately 177 inches high and 24 inches in diameter, with a wall thickness of approximately 0.1345 inches and a nominal capacity of 43 cubic feet. The IHLW canisters will be constructed of austenitic (304L) stainless steel.

Based on results from the programs at the Oak Ridge National Laboratory and Savannah River Technology Center, the 304L stainless steel is physically and chemically compatible with the IHLW glass waste.

Miscellaneous Mixed Waste

Generally, miscellaneous mixed wastes are secondary wastes that may include, but are not limited to, the following items:

- Spent or failed equipment
- Spent, dewatered ion exchange resins
- Off-gas HEPA filters
- Melter consumables
- Laboratory waste
- Out-of-service melters

Spent equipment and off-gas filters will typically be managed in commercially-available containers such as steel drums or steel boxes, of varying size. The containers for miscellaneous mixed waste will comply with receiving TSD waste acceptance criteria, and will be compatible with the miscellaneous mixed waste. These containers may or may not include a liner. Final container selection, container and waste compatibility, and the need for liners, will be based on the physical, chemical, and radiological properties of the waste being managed.

Spent, dewatered ion exchange resins will be managed in containers that will be approximately 100 in. high by 88 in. on a side. This waste will be generated and managed in the pretreatment plant, until it is moved to the central waste storage area or shipped to a Hanford Site TSD unit for further management. The containers for this miscellaneous mixed waste will comply with receiving TSD waste acceptance criteria.

Melter consumables are routinely generated wastes and include spent feed tubes, pressure transducers, bubblers, and discharge risers. LAW melter consumables will be placed into steel containers of varying size. HLW melter consumables will be placed into commercially available steel containers.

The LAW locally shielded melter (LSM) is a *Resource Conservation and Recovery Act* (RCRA)(RCRA 1976) miscellaneous unit within a welded container or overpack. The radiological shielding containing the melter will serve as the melter's final disposal container. When the locally shielded melter has reached the end of its operational life, it will be disconnected from systems. The overpack will then be prepared for disposal.

After a HLW melter is deemed to be waste, it will be removed from service and placed in a welded steel container approximately 21 × 18 × 16 ft high.

Each miscellaneous mixed waste container will have associated documentation that describes the contents, such as waste type, physical and chemical characterization, and radiological characterization. This information will be retained within the plant information network.

Most miscellaneous secondary mixed wastes will be spent equipment and consumables such as pumps, air lances, HEPA filters, etc., and are not expected to contain liquids. If wastes are generated that contain liquids, these wastes may be treated to remove or absorb liquids, to comply with the receiving TSD waste acceptance criteria. In addition to solid wastes, the analytical laboratory will generate containerized liquid waste (labpacks).

<u>Miscellaneous Non-Radioactive Dangerous Waste</u>
Each non-radioactive dangerous waste container will have associated documentation that describes the contents, such as waste type and physical and chemical characterization. Typically, commercially available containers, such as steel drums, will be used. The types of containers used for packaging non-radioactive dangerous waste will comply with the receiving TSD waste acceptance criteria. However, final container selection, container and waste compatibility, and the need for liners will be based on the physical and chemical properties of the waste being managed.

4.2.1.2 Container Management Practices [D-1b]

The following paragraphs describe how each of the containers used at the WTP are managed.

4.2.1.2.1 Immobilized Glass Waste Containers

Immobilized glass waste containers will be moved remotely due to the high radiation content of the waste. A brief discussion of how the containers move through the WTP is presented below. The schematics of the locations for container storage areas located within the three plants are found in Appendix 4A. Stand-alone container storage area location schematics are found in Appendix 2A.

ILAW Containers

An empty container will be transported to a LAW glass pour cave and placed on a turntable designed to hold three containers. There are two ILAW pour caves at each melter, each with the capacity to manage three containers at a time. The container will be sealed to the melter discharge with a pour head connection. The glass waste will fill the container during the course of approximately 15 to 20 hours. The filled container will cool for 10 to 30 hours to reach glass transition temperature (approximately 400 ^{o}C to 500 ^{o}C), which characterizes the transformation from an equilibrated melt to a "frozen" glass structure. At this stage, the waste glass does not contain liquid and is in a viscous state that ultimately stabilizes to a solid.

The filled ILAW container will be lowered back onto the turntable. Once the container has cooled, it will be rotated to the import/export position. The container will then be lifted by a remotely operated crane onto a bogie and transported to the finishing line. In the event the finishing line becomes backed up, the container may be transported to the ILAW buffer container storage area. The containers will not be stacked. Storage area dimensions and maximum waste storage volumes are summarized in Table 4-2.

The container will be transported to the ILAW container-finishing containment building unit (see Section 4.2.4), where the level of waste glass will be measured and additional inert filler will be added, if needed, to fill the container. A sample of the glass may also be collected in this location prior to inert filling. Glass within the neck of the container will be removed by abrasion and the lid will be attached to the container. The debris generated from residual glass removal will be collected with a vacuum system and disposed of as a secondary waste.

After lid welding is complete, the container will be moved to one of the two ILAW decontamination cells in the containment building unit, where contamination will be removed. Using a turntable, the container will revolve while a power manipulator tracks the entire surface with decontamination equipment. The dry decontamination process will use carbon dioxide pellets. The container will then be transported to one of the two ILAW swabbing cells, where its surface will be swabbed with a soft absorbent material. The radiation levels of the swab will be remotely monitored, and the results will determine whether the ILAW container will go to the ILAW container storage area or through decontamination again.

A container may also be transported to the ILAW container fixative area, where a fixative can be sprayed onto the its surface to immobilize detected radiological contamination. The container will then be transferred to the ILAW fixative curing cell area, where the fixative will be allowed to set. Container rework may also occur in this area. The container will then be moved to the ILAW container storage area. The containers will not be stacked. Storage area dimensions and maximum waste storage volumes are summarized in Table 4-2.

When the container is ready to be shipped out of the ILAW container storage area it will be transported to the export area, where it will be placed into a cask.

<u>IHLW Canisters</u>

The empty canister will be remotely transported to one of the two IHLW pour stations. The canister will be sealed to the melter pour spout with a pour head, and glass waste will fill the canister during the course of approximately two days. After filling, a temporary lid will be placed on the canister, which will be allowed to cool to glass transition temperature (approximately 400 ^{o}C to 500 ^{o}C), which characterizes the transformation from an equilibrated melt to a "frozen" glass structure, prior to transportation to the IHLW canister weld containment building unit (see Section 4.2.4).

The IHLW canister will be transferred to the IHLW canister weld containment building unit by means of an overhead crane. Here it will be stored on an open rack for up to three days, until it cools to normal operating temperature. Normal operating temperature is the temperature at which the canister can be lidded. This temperature range is 70 F to 350 F. In addition to providing a cooling area, the IHLW weld containment building unit can be used as a buffer to hold canisters awaiting lid welding or decontamination.

After it has cooled, the volume of glass in the canister will be determined. The canister will then be inspected for glass spatter on its exterior. If glass is found, it will be removed using a needle gun and the debris generated will be collected with a vacuum system and disposed of as a secondary waste. The temporary lid will be removed and residue on the lid or within the neck of the canister will be removed by abrasion. The lid will be attached by welding, to seal the canister completely and permanently.

The sealed canister will be transported to the IHLW canister decontamination containment building unit. The canisters are first rinsed with de-ionized water and then decontaminated using a cerium nitrate and nitric acid bath. It will then be rinsed with nitric acid, followed by a de-ionized water rinse, and then wiped or swabbed with a soft absorbent material. The radiation levels of the swab will be monitored.

The canister will then be moved to the IHLW canister storage area where it will be stored until transported off-site inside a shielded shipping cask. The canisters will not be stacked. Storage area dimensions and maximum waste storage volumes are summarized in Table 4-2.

<u>Other IHLW and ILAW Container Storage Requirements</u>

As stated under WAC 173-303-630(5)(c), a 30 in. separation is required between aisles of containers holding dangerous waste. In addition, WAC 173-303-340(3) requires a 30 in. separation to allow unobstructed movement of personnel, fire protection equipment, spill control equipment and decontamination equipment in an emergency.

Evaluation of the 30-inch aisle spacing requirement by the DOE, WTP, the EPA, and Ecology for ILAW and IHLW containers concluded that aisle spacing in the range of 4 to 16 inches was adequate based on the following factors:

- Personnel access into the immobilized glass container storage areas will be restricted. High radiation dose rates from immobilized glass waste containers will preclude personnel entry into the process and storage areas, and inspection of the ILAW and IHLW containers will be performed remotely. (See Chapter 6 for the inspection approach).
- Water-based fire suppression systems will not be used in the container storage areas. Because of its inert nature, the glass waste will present a low fire hazard, and a minimal amount of combustible material will be present. The only potentially combustible material that may be present in the immobilized glass waste container storage areas is insulation on crane motors and associated cables. To ensure no water is introduced into the container storage areas, a dry chemical fire suppressant system may be installed.
- Spill control equipment will not be necessary within the container storage areas. Spills or leaks from the stored containers will not occur because the glass waste will be in a solid form and will not contain free liquid. The glass transition temperature characterizes the transformation from an equilibrated melt to a "frozen" glass structure. Preliminary estimates show that ILAW glass waste will cool to the glass transition temperature in 10 to 30 hours, while the cooling time will be less for the smaller IHLW containers.

The ILAW containers will be stored on the floor of the storage area. The IHLW containers will be stored in a storage rack to allow airflow. No stacking of the containers will occur in the ILAW or the IHLW container storage areas. Closed circuit television cameras will enable general viewing of both areas.

Miscellaneous Mixed Waste Containers

Miscellaneous mixed waste (secondary waste) will be managed in:

- LAW container storage area
- HLW container storage area 1
- HLW container storage area 2
- HLW container storage area 3
- Central waste storage facility

Containers will be kept closed when managed in the container storage areas. Containers stored in these areas will be placed on pallets, or otherwise elevated to prevent contact with liquid, if present. Table 4-2 summarizes the dimensions and maximum capacity of miscellaneous mixed waste storage areas. Containers will be managed in the HLW vitrification, and LAW vitrification plants, and then transferred to the central waste storage facility.

The LAW container storage area will be located in the western portion, on the main floor or ground level of the LAW vitrification plant. The aisle space will be 30 inches, and the waste containers will not be stacked. This units' storage capacity is listed in Table 4-2.

The HLW container storage area 1 will be located in the eastern portion of the main floor (0 foot elevation) of the HLW vitrification plant. This unit will be used as a storage location prior to export of secondary waste containers out of the plant. Aisle space will be 30 inches and waste containers may or may not be stacked. This units' storage capacity is listed in Table 4-2.

The HLW container storage area 2 will be located in the eastern portion on the 11 foot elevation of the HLW vitrification plant. The unit will be used for storage of the miscellaneous waste containers prior to storage in the central waste storage facility. The aisle space will be 30 inches and waste containers may or may not be stacked. This units' storage capacity is listed in Table 4-2.

The HLW container storage area 3 will be located in the eastern portion on the 11 foot elevation of the HLW vitrification plant. The unit will be used for storage of the miscellaneous waste containers prior to storage in the central waste storage facility. The aisle space will be 30 inches and waste containers may or may not be stacked. This units' storage capacity is listed in Table 4-2.

The central waste storage facility is a waste container storage area where containers of mixed waste are received from various WTP facilities in a ready-to-transport state for consolidation into truck-load shipments. The central waste storage facility is a prefabricated metal structure on a concrete foundation pad. The foundation will be constructed to support fork-lift traffic and the waste containers will be palletized. Containers may be stacked on pallets no more than two high. Aisle spacing will be at least 30 inches. The perimeter of the central waste storage facility concrete base will be curbed to ensure that rain water does not infiltrate the waste storage area. The concrete base will be covered with a protective coating, and sloped to a grated sump. The containerized waste, which may be radioactive or mixed waste, will be fully characterized and required sampling will be completed prior to transfer to central waste storage facility. Waste containers will qualify for contact handling and meet the current applicable waste acceptance criteria established by the receiving storage, treatment, or disposal facility.

The central waste storage facility will not have capabilities for waste repackaging, waste compaction, waste reduction, grouting, or other form of waste treatment or internal waste inspection. Waste containers will not be opened at the central waste storage facility. The central waste storage facility may receive waste container containing free liquids, ignitable or reactive waste, or lab packs that contain liquids, ignitable, or reactive waste. Waste that is returned to WTP will be routed to the generating facility where the waste originated for resolution of discrepancies or issues. This units' storage capacity is listed in Table 4-2. As the facility will not be treating, repackaging, or opening waste containers, emission control equipment is not anticipated.

<u>Miscellaneous Non-Radioactive Dangerous Waste Containers</u>
Miscellaneous dangerous waste containers will be managed in a stand-alone building (the non-radioactive dangerous waste container storage area). This container storage area will have a protectively-coated concrete floor and a 10 ft high metal roof. Containers will be kept closed unless waste is being placed inside them. They will routinely be moved by forklift or drum cart, and will be managed in a manner that prevents rupturing or leaking. The non-radioactive dangerous waste container storage areas' storage capacity is listed in Table 4-2. The containers

may be stacked two high. The aisle spacing will be 30 inches between rows of containers. Containers stored in this area will be placed on pallets, or otherwise elevated to prevent contact with liquid, if present.

4.2.1.2.2 Waste Tracking

The plant information network will be a manufacturing execution system designed to collect and maintain information enabling the optimization of the WTP activities from order launch to finished product. The plant information network consists of software applications designed to meet specific requirements and functions.

The plant information network will consist of the following systems:

- Maintenance management system
- Plant data warehouse and reporting system
- Laboratory information management system
- Waste tracking and inventory system

The plant information network will interface with the integrated control network. The integrated control network will consist of the process control system, mechanical handling control system, and the autosampling control system.

Inventory and Batch Tracking
The waste tracking and inventory system serves as the main repository for the relevant information pertinent to a given waste batch. Data is collected for each sequence or step throughout the processing history of a given batch of waste, from receipt of raw feed to disposition of the finished products, including secondary waste. At the end of a batch cycle, the data applicable to that particular batch will be catalogued to facilitate historical recording and reporting.

The waste tracking and inventory system will also record the inventory of immobilized waste containers, including the data generated for each immobilized waste container, and final quality assurance checks. Each immobilized waste container will bear a unique identification number to facilitate tracking.

Sample Tracking
Sampling activities will be started, monitored, and controlled by the integrated control network, with key sequence durations and operations logged into the waste tracking and inventory system directly from the integrated control network. Sampling operations will be requested by the integrated control network, plant operators, or laboratory personnel. These requests will be time and date stamped, as will the actual sampling operation and the associated sample handling and laboratory activities. Sample requests and operations will be channeled through the integrated control network, which will operate in a supervisory capacity and will communicate the necessary information to the waste tracking and inventory system.

The laboratory information management system will be an integral feature of the plant information network. Workstations will be located within the laboratory and the plant control rooms. The laboratory information management system will record the required quality control checks to assure correct sample preparation and selection of analyses, and controlled checking and approval of results.

Sample containers received in the laboratory preparation area will be identified by their identification label. The identification label provides details of the sample source and, therefore, specifies the required preparation and analysis techniques. The identification will be registered at the locations where manual intervention is required, such as manual samplers. The results of calibration checks on equipment and analyzers will be recorded.

Analytical results will be compiled by the laboratory information management system and held, pending checking and approval by laboratory staff, before formally recorded within the waste tracking information system. Results that affect the progression of the main plant process will be communicated to appropriate plant personnel where required. WTP samples that come under the exclusion provided in WAC 173-303-071(3)(l) may not be tracked.

Secondary Waste Stream Tracking

Secondary waste streams will be tracked within the waste tracking and inventory system in a manner similar to that primary waste streams. Secondary waste streams will be managed by using assigned, unique identification numbers. Corresponding histories and data collection triggers will gather process and status information during the processing of secondary waste in order to satisfy tracking of waste disposal records. Shipments of overpacks will be labeled and tracked as part of the inventory control function of the waste tracking and inventory system.

Maintenance, decommissioning, or disposal activities may generate consumables, including such items as equipment, hardware, personal protective equipment, and materials used in the normal operation of the Plant. Consumables that are designed as dangerous will be tracked by the maintenance management system, with appropriate fields denoting the hazardous classification of the disposed parts and materials, and cross-linked to disposal records. Waste being accumulated in satellite accumulation areas under the provisions of WAC 173-303-200 may not be tracked until it has been accepted into a permitted portion of the WTP.

4.2.1.3 Container Labeling [D-1c]

Immobilized Waste Glass Containers

Due to the radioactivity and remote handling of the immobilized waste containers, conventional labeling of the immobilized waste containers will not be feasible and an alternative to the standard labeling requirements will be used. This alternative labeling approach will use a unique alphanumeric identifier that will be welded onto each immobilized glass waste container. The welded “identifier” will ensure that the number is always legible, will not be removed or damaged during container decontamination, will not be damaged by heat or radiation, emits no gas upon heating when waste glass enters the container, and will not degrade over time.

The identifier will be welded onto the shoulder and side wall of each immobilized glass container at two locations 180 degrees apart. Characters will be approximately 2 in. high by 1.5 in. wide (See Figures 4A-118 and 4A-119 for examples of these identifiers). The identifier will be formed by welding on stainless steel filler material at the time of container construction. This identifier will be used to track the container from receipt at the WTP, throughout its subsequent path at the WTP, until it leaves the plant to be disposed or stored.

Each identifier will be composed of eight coded alphanumeric characters. For example, HL123456 would be an immobilized waste glass container storing Hanford LAW with the unique number 123456, and HH123456 would denote an IHLW container. This unique number will be maintained within the plant information network, and will list data pertaining to the waste container including waste numbers, and the major risk(s) associated with the waste.

Personnel access into the immobilized glass waste container storage areas will be limited and controlled administratively. Signs designating the hazards associated with the immobilized waste glass will be posted at appropriate locations outside the container storage areas.

<u>Miscellaneous Mixed Waste Containers</u>
The miscellaneous mixed waste containers will be labeled with the accumulation or generation start date, as appropriate, the major risk(s) associated with the waste, and the words "hazardous waste" or "dangerous waste". A waste tracking and inventory system will be implemented. Labels and markings will be positioned so that required information is visible. The label will meet the WAC 173-303-630(3) requirements, and the dangerous waste number will be clearly identified.

The labels on the overpack for the spent or failed melters will carry the accumulation or generation start date, the major risk(s) associated with the waste, and the words "hazardous waste" or "dangerous waste". A waste tracking and inventory system will be implemented. Labels and markings will be positioned so that required information is visible, and the dangerous waste number will be clearly identified.

<u>Miscellaneous Dangerous Waste Containers</u>
The miscellaneous dangerous waste drums will be labeled with the accumulation or generation start date, as appropriate, the major risk(s) associated with the waste, and the words "hazardous waste" or "dangerous waste." A waste tracking and inventory system will be implemented. Labels and markings will be positioned so that required information is visible. The label will meet the WAC 173-303-630(3) requirements, and the dangerous waste number will be clearly identified.

4.2.1.4 Containment Requirements for Storing Waste [D-1d]

The wastes managed in the immobilized waste container storage areas, and the limited amount of other materials present in the majority of the container storage areas, do not require secondary containment, as discussed below.

4.2.1.4.1 Secondary Containment System Design [D-1d(1)]

ILAW and IHLW

Secondary containment is required for areas in which containers hold free liquids. It is also required for areas managing wastes exhibiting the characteristic of ignitability or reactivity as defined in WAC 173-303-090(5) and (7). These requirements do not pertain to the ILAW and IHLW container storage areas, as these containers will not contain free liquids or wastes that are designated ignitable or reactive.

Miscellaneous Mixed Waste

Secondary containment is required for areas in which containers hold liquids. It is also required for areas managing wastes exhibiting the characteristic of ignitability or reactivity as defined in WAC 173-303-090(5) and (7). It is anticipated that miscellaneous mixed waste will not contain liquids; therefore, these requirements should not pertain to the WTP container storage areas, with the exception of the central waste storage facility. However, in the event that wastes containing liquids or wastes exhibiting the characteristics of ignitability or reactivity are generated, portable secondary containment that meets the requriements of WAC 173-303-630(7) will be provided.

The central waste storage facility may receive wastes that contain liquids or are incompatible. The central waste storage facility will be designed to meet the secondary containment requirements of WAC 173-303-630(7), and will include a protective coating on the floor, berms, sloped floors, sumps, and/or portable secondary containments. Wastes that do not contain free liquids or other disqualifying wastes will not require secondary containment. Incompatible waste will be managed in accordance with appropriate requirements.

Miscellaneous Dangerous Waste

Wastes that do not contain liquids or other disqualifying wastes will not require secondary containment. Containers with liquids will be provided with secondary containment in the form of portable secondary containments made of high-density polyethylene or equivalent material to ensure containment. The secondary containments will have a capacity that meets the requirements of WAC 173-303-630(7), and will have a two-way forklift entry.

4.2.1.4.2 System Design [D-1d(1)(a)]

ILAW

There will be two container storage areas for the ILAW containers in the LAW vitrification plant, as follows:

- ILAW buffer container storage area
- ILAW container storage area

Both the ILAW container storage areas will be located in the LAW vitrification plant, which is designed to be seismically qualified, as outlined in Supplement 1. A secondary containment system will not be needed because the immobilized glass waste will not contain liquid. In addition, because liquid is not expected within the ILAW container storage area, the floor will not be sloped and will not contain drains or sumps.

Liquid will not be present within the ILAW container storage areas for the following reasons:

- Administrative controls will ensure liquid does not enter or condense inside filled ILAW containers
- The ILAW container storage areas will be completely enclosed within the LAW vitrification plant
- The roof of the LAW vitrification plant will be metal roofing, roof insulation, and a vapor barrier
- Penetrations to the storage areas will be sealed to prevent water ingress
- Rainwater will be directed away, using roof drains

Schematics of the ILAW container storage areas are shown in Appendix 4A.

<u>IHLW</u>
There will be one container storage area for the IHLW containers in the HLW vitrification plant, as follows:

- IHLW container storage area

The IHLW container storage area will be located in the HLW vitrification plant, which is designed to be seismically qualified, as outlined in Supplement 1. A secondary containment system will not be needed because the immobilized glass waste will not contain liquid. In addition, because liquid will not be present in the IHLW container storage area, the floor will not be sloped and will not contain drains or sumps.

Liquid will not be present within the IHLW container storage area for the following reasons:

- Administrative controls will ensure that liquid does not enter or condense inside filled IHLW containers
- The IHLW container storage area will be completely enclosed with a metal roof
- Penetrations to the storage area will be sealed to prevent water ingress
- Rainwater will be directed away using roof drains

A schematic of the IHLW container storage area is shown in Appendix 4A.

<u>Miscellaneous Mixed Waste</u>
There will be six miscellaneous mixed waste (secondary waste) container storage areas at the WTP, as follows:

- LAW container storage area

- HLW container storage area 1
- HLW container storage area 2
- HLW container storage area 3
- Central waste storage facility
- HLW out-of-service melter storage facility
- LAW out-of-service melter storage facility

The LAW container storage area, and the HLW waste container storage areas will be located within the LAW or HLW vitrification plants, respectively. Therefore, these units will be completely enclosed within the plants, which will have metal roofing, roof insulation, and a vapor barrier. Penetrations to the storage areas will be sealed to prevent water ingress, and rainwater will be directed away using roof drains.

The central waste storage facility will be a metal-sided building with a concrete floor sloped to a grated sump. Secondary containment sumps will be provided for individual containers. The perimeter of the concrete floor will be curbed. Access to the building will be through two rollup doors capable of allowing forklift access, and one personnel door. It will have a metal roof, concrete floor, and concrete block walls. The floor and lower portion of the walls will be covered with a protective coating. The floor will be sloped to a grated sump.

The HLW out-of-service melter storage facility will be used primarily to manage HLW melters that have completed their useful service life. These units will be received in steel overpack containers allowing limited hands-on contact. These overpacks will not be opened while the waste melters are located in this storage facility. The facility is capable of storing up to three waste melters at any given time. The out-of-service HLW melters will not be stacked.

The HLW out-of-service melter storage facility may also receive containerized miscellaneous waste similar to that managed in the central waste storage facility. These waste containers will be sealed prior to transport to the HLW out-of-service melter storage facility. The containers will not be opened while at this storage facility. The waste containers will not be stacked more than two containers high. The HLW out-of-service melter storage facility will be a stand-alone building located in the southern portion of the WTP.

The LAW out-of-service melter storage facility will be a stand-alone building located in the southern portion of the WTP. The LAW out-of-service melter storage facility will be a prefabricated metal building anchored to a reinforced concrete foundation. The floor will be covered with a protective coating and sloped to a grated sump. The LAW out-of-service melter storage facility will be used primarily to manage LAW melters that have completed their useful service life. The integral shielding of the locally shielded melter allows hands on contact. The facility is capable of storing up to two waste melters at any given time. The waste LAW melters will not be stacked.

The LAW out-of-service melter storage facility may also receive containerized miscellaneous waste similar to that managed in the central waste storage facility (no waste containing liquids, no ignitable or reactive waste will be stored at this facility). The containers will not be opened while at this storage facility. The waste containers will not be stacked more than two containers high.

Miscellaneous Dangerous Waste
Waste containing liquid may be present in the non-radioactive dangerous waste storage area. Containers with liquids will be provided with secondary containment in the form of portable secondary containments made of high-density polyethylene or equivalent material to ensure containment. The secondary containments will have a capacity that meets the requirements of WAC 173-303-630(7), and will have a two-way forklift entry.

4.2.1.4.3 Structural Integrity of the Base [D-1d(1)(b)]

The storage areas will be constructed to support storage and transportation of containers within the container storage areas and will be designed with the following:

- Containment system capable of collecting and holding spills and leaks
- Base will be free of cracks and gaps and sufficiently impervious to contain leaks
- Positive drainage control
- Sufficient containment volume
- Sloped to drain or remove liquid, as necessary

4.2.1.4.4 Containment System Capacity [D-1d(1)(c)]

ILAW and IHLW
Because liquids will not be present in the containment system for these three units, a containment system capacity demonstration is not required.

Miscellaneous Mixed Waste
The LAW container storage area and the HLW container storage areas do not require secondary containment because storage of liquids in these units is not anticipated. If the waste is found to contain liquid, secondary containment will be provided that meets the requruiements of WAC 173-303-630(7).

Liquid waste may be stored in the central waste storage facility. Secondary containment will will have the capacity to contain ten percent of the volume of all containers or the volume of the largest container, whichever is greater.

Miscellaneous Dangerous Waste
Waste containing liquid may be present in the non-radioactive dangerous waste container storage area. Each container holding liquid non-radioactive dangerous waste will be placed into portable secondary containment. The waste container will function as the primary containment while the portable sump will function as the secondary containment. Each portable secondary

containment will have the capacity to contain ten percent of the volume of all containers or the volume of the largest container, whichever is greater. Typically, the waste containers will be in steel drums.

4.2.1.4.5 Control of Run-on [D-1d(1)(d)]

ILAW and IHLW

The ILAW and IHLW container storage areas will be located in the LAW and HLW vitrification plants. The requirements for this section do not apply because the immobilized glass waste container storage areas are within the vitrification plants and therefore will not be exposed to run-on.

Miscellaneous Mixed Waste

Run-on will not reach the interior of the miscellaneous mixed waste storage areas, because they will be located within buildings, which will have roof gutters to remove precipitation.

Miscellaneous Dangerous Waste

Run-on will not reach the interior of the miscellaneous dangerous waste container storage area, because it will be a stand-alone building with walls and roof gutters to remove precipitation.

4.2.1.4.6 Removal of Liquids from Containment System [D-1d(2)]

ILAW and IHLW

No liquids will be present in the containment system; therefore, the requirements of this section do not apply to the immobilized waste glass container storage areas.

Miscellaneous Mixed Waste

Portable secondary containment sumps will be provided for individual containers that contain liquids. Hand pumps or similar devices will be used to remove liquid released to the portable secondary containments.

Miscellaneous Dangerous Waste

Portable secondary containment sumps will be provided for individual containers that contain liquids. Hand pumps or similar devices will be used to remove liquid released to the portable secondary containments.

4.2.1.4.7 Demonstration that Containment is not Required because Containers do not Contain Free Liquids, Wastes that Exhibit Ignitability or Reactivity, or Wastes Designated F020-023, F026 or F027 [D-1e]

ILAW and IHLW

The ILAW and IHLW container storage areas will not contain liquids. The vitrification process volatilizes water or other liquid materials existing at ambient conditions in the waste slurry feed that enters the melter.

The waste numbers for ignitability (D001) and reactivity (D003) will not be managed in the immobilized glass container storage areas. Wastes with the F020-F023, F026, and F027 numbers are not identified for the DST system unit. Therefore, these waste numbers will not be present at the WTP.

Miscellaneous Mixed Waste

Liquids may be present in wastes in the central waste storage facility, and the miscellaneous dangerous waste container storage area. Secondary containment will be provided for individual containers that manage liquids. The waste numbers for ignitability (D001) and reactivity (D003) will not be managed in the miscellaneous mixed waste storage areas. Wastes with the F020-F023, F026, and F027 numbers are not identified for the DST system. Therefore, these waste numbers will not be present at the WTP.

Miscellaneous Dangerous Waste

The miscellaneous dangerous waste container storage area may manage liquids and D001 and D003 waste; therefore, secondary containment will be provided. Wastes with the F020-F023, F026, and F027 numbers are not identified for the DST system unit. Therefore, these waste numbers will not be present at the WTP.

4.2.1.5 Prevention of Reaction of Ignitable, Reactive and Incompatible Wastes in Containers [D-1f]

Ignitable, Reactive, or Incompatible ILAW and IHLW

Immobilized glass waste will not be ignitable, reactive, or incompatible with the wastes managed in the ILAW and IHLW container storage areas. The requirements of this section are not applicable to the immobilized glass waste containers, including spent or failed melters.

Ignitable, Reactive, or Incompatible Miscellaneous Mixed Waste

Potentially incompatible wastes are not expected to be managed in the miscellaneous mixed waste storage areas. If such wastes are managed here, the containers of incompatible waste or chemicals will not be stored in close proximity to each other. Acids and bases will be stored on portable secondary containment sumps; oxidizers will be stored in areas separate from combustible materials; and corrosive chemicals will be stored on a separate secondary containment sump. These separate storage areas within the unit will be clearly marked with signs indicating the appropriate waste to be stored in each area. Potentially incompatible waste will be stored at least one aisle width apart.

4.2.2 Tank Systems [D-2]

This section contains descriptive information for each tank system used for managing mixed waste. The term “tank systems” refers to mixed waste storage or treatment tanks and their associated ancillary equipment and containment systems. Figures depicting design features of typical tank systems are found in Appendix 4A.

The following text uses the terms vessel and tank. The term “vessel” is an engineering term and denotes more robust construction than a typical mixed waste storage or treatment tank. The term vessel is included due to the use of the term in the American Society of Mechanical Engineer

(ASME) codes and specifications, which will be followed, for most tank construction at the WTP.

4.2.2.1 Design, Installation and Assessment of Tank Systems [D-2a]

This section describes the attributes of tank systems that will contain mixed waste. Tanks and ancillary equipment containing only additives or reagents, such as glass-forming chemicals, precipitation reagents, or unused resin are not regulated under RCRA or the Washington State Dangerous Waste Program, and are therefore not included.

Tank systems that will contain mixed waste are designed to comply with worst-case scenarios, such as extreme pH, temperature, and pressure conditions. The WTP will be entirely new construction and there will be no “existing tanks” in the plant. Tank systems, with the exception of the two outside tanks at the pretreatment plant, will be located indoors and within process cells, process rooms, or caves with controlled access.

4.2.2.1.1 Design Requirements [D-2a(1)]

<u>Tanks</u>

Most of the tanks which come in contact with the waste will be operated under atmospheric pressure conditions at the WTP. The mixed waste tanks will be designed, at a minimum, to *Boiler and Pressure Vessel Code* (ASME 2000), the American Petroleum Institute (API) codes, or other appropriate design codes. Tank integrity will be reinforced by additional requirements of the tank group and seismic category assignment to each tank. Five vessel or tank groups will be designated to accommodate the variations in design criteria and safety requirements of the WTP. Groups 1 through 3 will be high-integrity vessels and will be located within cells or caves. Group 4 will be medium-integrity and Group 5 will be constructed to commercial standards. Some general vessel or tank design requirements are summarized as follows:

- The approximate minimum thickness of uncorroded cylindrical shell and dished head will be determined based on the vessel diameter.
- The minimum anchor bolts, where used, will be 0.75 in. in diameter, Unified National Code (coarse thread) bolts.
- Three types of tank supports may be used: skirts, saddles or legs.
- Minimum wall thickness for a nozzle neck or other connection (including access and inspection openings) will comply with the requirements of ASME Code paragraph UG-45 (ASME 1996).
- The vessels will be designed for seismic loading in accordance with the Uniform Building Code (UBC) standard for Zone 2B (UBC 1997).

The codes and standards that will be followed for design, construction, and inspection for the tanks are identified below, as applicable:

ANSI	American National Standards Institute

API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
ASNT	American Society of Non-Destructive Testing
ASTM	American Society of Testing Materials
EPA	Environmental Protection Agency
NBBPVI	The National Board of Boilers and Pressure Vessel Inspectors
OSHA	Occupational Safety and Health Administration
PFI	Pipe Fabrication Institute
UBC	Uniform Building Code
WRC	Welding Research Council

Piping and Pipe Support Design

The design code of the WTP piping and pipe supports is ASME B31.3 Code (ASME 1996), as well as the DOE seismic requirements. In compliance with DOE seismic requirements (DOE 1996), response spectrum method or UBC (UBC 1997) static method is used for the seismic analysis of the piping systems.

The codes and standards that will be followed for design and construction of the piping and supports are identified below:

- ASME B31.3 Code – *Chemical Plant and Petroleum Refinery Piping* (ASME 1996)
- ASME Section III Code – *Rules for Construction of Nuclear Facility Components* (ASME 1995)
- Code Case N-411 – *Alternative Damping Values for Response Spectra Analysis of Classes 1, 2, and 3 Piping, ASME Section III Code* (ASME 1998)
- Uniform Building Code (UBC 1997)
- ASME/ANSI B16.5 - *Pipe Flanges and Flanged Fitting*s (ASME 1999)
- DOE-STD-1020-94 (DOE 1996)

Table 4-13 summarizes the seismic categories and design standards for piping and pipe supports.

4.2.2.1.2 Physical Information for Tanks

Tables 4-3 through Table 4-6 list current tank design information (capacity, materials of construction, and dimensions). The tank systems are grouped by plant and process system.

Tank operation is generally automated. However, operator intervention can be used when human decisions or approval are required for initiation and termination of a process operation. Descriptions of tank system operation for major WTP process systems are identified in Sections 4.1 and 4.2.2.

4.2.2.2 Ancillary Equipment Requirements [D-2a(1)]

Information concerning ancillary equipment is provided in the following subsections.

4.2.2.2.1 Transfer or Pressure Control Devices

Several fluid transfer devices will be used in the WTP. These devices include: mechanical pumps, reverse flow diverters, and steam ejectors. Breakpots and seal pots, although not fluid transfer devices, are an important component of vessel operations. These components are discussed in the following sections.

<u>Mechanical Pumps</u>
Mechanical pumps will be used for operations that require high-flow pumps (such as through the evaporator circuits) or high-pressure head pumps (such as for pumping a waste stream through ultrafiltration circuits). Mechanical pumps will be located in process cells, process rooms or caves. In general, mechanical pumps will be repaired in place, or removed to a maintenance area. However, remotely maintained pumps will be used in areas where maintenance activities would result in a significant radiation dose to the operators.

For normal process operating sequences, mechanical pumps and associated valves will be controlled by the process control system. In systems where off-normal conditions would require pump shutdown, the design will include an alarm mechanism which will also trip the transfer device. The pump system is designed to allow for the drainage of liquid from the pump, and for the introduction of flush liquids at the end of transfers to reduce residual contamination.

<u>Reverse Flow Diverters</u>
Reverse flow diverters will provide for the maintenance-free pulsed or metered transfer of liquids or slurries throughout the treatment process. A reverse flow diverter does not need to be fully submerged in order to remove the contents of a vessel, and it maintains a small and predictable volume of tank contents following its use. Operation of the reverse flow diverter is cyclical, following timed phases: suction phase, drive phase and blowdown. Figure 4A-120 and the following paragraphs describe a typical reverse flow diverter system arrangement. Figure 4A-121 illustrates a typical flow diverter.

<u>Suction phase:</u> In the suction phase, the secondary automatic valve A is open, admitting air to the suction jet pump. Valve B is shut and liquid is drawn from the supply tank through the reverse flow diverter and into the charge vessel. The suction ejector is designed so that it cannot produce a vacuum capable of lifting liquid higher than a certain valve known as the "suction lift." After a short time, the liquid reaches this "suction lift" height and stops, then valve A is shut.

<u>Drive phase:</u> When valve A is shut, valve B is opened, admitting air to the drive nozzle. Air passes through the nozzle and pressurizes the charge vessel. Liquid is forced across the reverse flow diverter and into the delivery pipe. The delivery pipe is quickly filled with liquid that flows into the delivery vessel.

Blowdown phase: When the charge vessel is nearly empty, valve B is shut; no air is supplied to either jet pump. The compressed air in the charge vessel passes back through the paired jet pumps, down the vent pipe and into vessel vent system.

Shortly after blowdown begins, the pressure in the charge vessel falls below the delivery head and the flow of liquid into the delivery vessel is halted. The liquid in the delivery vessel then falls back down the pipe, across the reverse flow diverter, and into the charge vessel. After a short time, the pressure in the charge vessel falls to zero (gauge). The cycle is now complete.

Steam Ejectors

Steam ejectors are used to transfer process liquids, or to reduce the operating pressure of a system by gas removal. They empty liquid from vessels by means of suction lift, using a simple control system. A typical arrangement of a steam ejector system is shown in Figure 4A-122.

An automated control valve supplies high-pressure steam to the steam ejector. This steam accelerates through a nozzle, creating a differential pressure along a submerged suction leg within the vessel. The pressure than forces the liquid up the suction pipe. This effect is known as striking. The steam then conveys the liquid to the destination vessel, normally via a breakpot. Control is established using liquid level instrumentation in the vessel being emptied, and using a temperature indicator, such as a thermocouple, within the breakpot.

Seal Pots

A seal pot is a type of hydraulic seal. A hydraulic seal is used primarily to maintain a separation between vessel vent or off gas systems for feed and receipt vessels. This separation is necessary to prevent migration of airborne contamination between the vessels. Without the seal, airflow could occur due to the different pressures in the vent systems. The seal is a slug of liquid in the interconnecting pipework that remains after each liquid transfer is completed, blocking airflow between vessels.

The seal can be provided by constructing a simple “U” shape in the piping. Different piping arrangements are used for different purposes. A seal pot is a small vessel with one (inlet or outlet) pipe submerged in the liquid slug in the lower part of the pot, while the other pipe terminates in the top of the pot, above the static liquid level. The pot may be provided with a level indicator or alarm, if necessary, to ensure adequate liquid level. Periodic liquid additions may be needed to maintain the seal, especially if the pipeline is infrequently used. Figure 4A-123 illustrates a typical seal pot.

Breakpots

The main function of the breakpot is to reduce the amount of radioactive material entrained into the vessel ventilation system. Breakpots are provided on transfer lines that use steam ejectors for moving radioactive liquors by pressure flow. These types of transfers create the potential for higher containment of radioactive contamination. Breakpots function to convert steam from pressure-flow to liquid gravity flow, thereby reducing both the effluent loading on the downstream vessel ventilation treatment system and the radioactive contamination levels in the vessel vent ductwork. Breakpots also serve a secondary purpose by providing a siphon break for other transfer systems where siphoning could occur. A diagram of a breakpot is shown in Figure 4A-124.

Breakpots are typically placed at a high point in the discharge line from the steam ejector. Liquid will be pumped into the breakpot through an inlet nozzle in its wall. The incoming liquid will be directed towards a baffle. Within the baffle, non-condensed steam and gases will disengage. The breakpot will be self-draining; the liquid will drain through the breakpot discharge pipe to the destination vessel.

Above the inlet nozzle(s) will be a packed bed where disentrainment of the gas stream will occur. The exiting gas from the packed section will pass into the vessel ventilation system. The packed bed can be washed periodically using a wash ring permanently installed above the packed bed. Within the packed bed, a thermocouple will be located inside a sheath to measure temperature.

4.2.2.2.2 Bulges

Bulges are intended for systems/equipment that are not radioactively “hot” after process fluids are flushed from the bulge piping and components to allow hands-on maintenance. Bulges provide shielding to personnel during process operation and allows vulnerable or failure prone components to be located outside the process environment. The cell wall provides shielding between the cell and the bulge interior. The bulge includes shielding and contamination control as needed, depending on the process fluid within the bulge piping. A typical bulge consists of a metal frame attached to the cold-side wall of a process cell, the frame is used to support the piping and components as well as the shielding plates (usually steel), which are bolted to the frame. A diagram of a typical bulge is shown in Figure 4A-127.

There are two classifications of bulges used at the WTP. One is a “process” bulge, the other is a “service” bulge. The process bulge contains valves, pumps, piping, etc. The service bulge contains valves used to transfer reagents, steam, etc., to the in-cell process equipment. The design of the two bulges is similar.

Bulges are equipped with several wash systems, facilitating washing both internal and external piping, components, and bulge confinement surfaces. Decontamination of the equipment internals and associated piping is achieved by externally connecting a flushing system located on the outside of the bulge. Wash fluids could be water or more aggressive media such as nitric acid, provided compatibility with the bulge materials is ensured. Bulges are internally lined with a stainless steel liner and are equipped with a sump, drain, and sump level instrumentation. The drains are connected to the plant wash system.

4.2.2.2.3 Description of WTP Piping System

<u>Interplant Piping</u>

Transfer Lines

Waste from the DST system will be transported to the WTP via the waste transfer lines.

The waste transfer line will be a double-walled pipe. The inner pipe will be constructed of stainless steel, while the outer pipe will be constructed of carbon steel. A leak detection system will be provided for the entire length of the waste transfer line. Pumping will be terminated, and reception of waste feed from the DST system unit will stop, when a leak is sensed by the leak detection system.

The inner pipe will be supported by guides, saddles, support keys, or anchors within the outer pipe. The inner pipe will transport waste and maintain the pressure boundary, while the outer pipe will provide secondary containment for the inner pipe. The piping system will be buried under a minimum depth of soil for radiation shielding. The minimum depth of soil will be finalized at the detail design phase and will be not less than the 2 foot freeze depth. A heat trace system is not required for pipes buried below freeze depth.

The piping system will have a continuous slope down toward the pretreatment plant. Released liquids resulting from leaks to the outer pipe can be removed as required by WAC-173-640(4)(b). The piping system will be designed to allow water flushing to occur in both directions.

Liquid Effluent Transfer Lines

Liquid effluent generated at the WTP will be routed to the pretreatment plant for recycling through the WTP or disposal to the LERF and ETF.. An effluent line will be routed from the pretreatment plant to the LERF and ETF. This line is a buried pipe, constructed of materials that are compatible with the waste, under a minimum two feet of soil serving as freeze protection. The pipes will have a continuous downwards slope towards the LERF and ETF, and will be designed to maintain structural integrity.

Intraplant Piping

Within plants, the pipelines associated with the tank system will be single-walled. Secondary containment will be provided for piping within the plants by double-walled pipe or lined process cells, process rooms, or caves. If needed, other containment methods such as a bulge or concrete ducts with liners will be provided at appropriate locations. The bulge or concrete ducts will be provided with a low point which will drain to process cells, process rooms, or caves. The leak detection equipment located within the process cells, process rooms, and caves will warn of a piping leak through alarms.

Piping between plants and the two outdoor tanks at the pretreatment plant will be double-walled below grade and below the freeze line, similar to the waste transfer line.

Cathodic Protection

An electrically powered cathodic protection system will be used for eliminating or mitigating corrosion on underground tanks and piping. The cathodic protection system will maintain a negative polarized potential within a range of approximately –0.850 milivolts relative to a saturated copper/copper sulfate reference electrode. An automatically controlled, impressed-current cathodic protection system is used to maintain the negative polarized potential.

The impressed current cathodic protection system uses direct current provided by a rectifier powered from the site normal 120 volt alternating current or 480 volt power system. The direct current from the rectifier flows to the buried or submerged impressed current anode. The current then flows from the anode, (positive terminal) through the electrolyte, to the cathode, (negative terminal) completing the electrical circuit.

An annual survey, recommended by the National Association of Corrosion Engineers standards will be performed on the overall system. Additional information on inspections is provided in Chapter 6 of this application. Test stations will be located to in the field to facilitate testing via potential measurement readings.

The following waste transfer lines use the cathodic protection system at the WTP. The waste transfer lines are double encased and constructed of materials that are compatible with the waste:

- Incoming waste feed lines to the pretreatment plant
- Mixed waste transfer lines between the pretreatment plant and the HLW vitrification plant
- Mixed waste transfer lines between the pretreatment plant and the LAW vitrification plant
- Radioactive/dangerous waste effluent transfer lines to the ETF

4.2.2.2.4 Description of Foundations

Tank systems containing mixed waste that will be located indoors in process cells or caves, which will be integral parts of the pretreatment plant, analytical laboratory, the LAW vitrification plant and the HLW vitrification plant with the exception of two outdoor tanks. Therefore, the design requirements of the tank systems will be met by the structural integrity of the plants. WTP compliance with Uniform Building Code seismic design requirements, found in Supplement 1, provides the seismic design requirements for the WTP. The outdoor tanks will be located outside of the pretreatment plant on a protectively-coated concrete pad and concrete berm. The concrete pad for these tanks will be sufficient to support the tanks.

4.2.2.3 Integrity Assessments [D-2a(2)]

This section discusses assessment of the structural design of the tanks and foundation.

A written assessment of the adequacy of the design, and the structural integrity and suitability of tank systems, including ancillary equipment, will be prepared. The assessment will be reviewed and certified by an independent qualified registered professional engineer, consistent with Page II-5 of OSWER Policy Directive #9483.00-3, to attest that the tank systems are adequately designed for managing dangerous waste. The assessment will include an evaluation of the foundation, structural support, seams, connections, pressure controls, compatibility of the waste with the materials of construction, and corrosion controls for each mixed waste tank system. The certification will read as follows:

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

The tank systems will be located indoors, except the vessels located outside the pretreatment plant (process condensate vessels, V45028A/B). The two outdoor tanks will be located on a concrete pad with concrete secondary containment.

Information regarding the Tank System Design Assessment is included in Appendices 8.10, 9.10, 10.10, 11.10, and 12.10.

4.2.2.4 Additional Requirements for Existing Tanks [D-2a(3)]

Tanks and vessels to be permitted in the WTP will be newly constructed; pre-existing tanks will not be used. Therefore, the requirements of this section do not apply.

4.2.2.5 Additional Requirements for New Tanks [D-2a(4)]

Installation of tank systems will be performed in a manner designed to prevent damage to the tank system. The WTP will use an independent, qualified installation inspector, or an independent qualified registered professional engineer (IQRPE) to perform tank system installation inspections. Inspection activities will include testing tanks for tightness, verifying protection of ancillary equipment against physical damage and stress, and evaluating evidence of corrosion. The inspections will document weld breaks, punctures, coating scrapes, cracks, corrosion, and other structural defects. Installation inspections will conform to consensus-recognized standards. Inspection findings and corrective actions will be documented in a post-inspection report. Additional information is provided in Appendices 8.11, 9.11. 10.11, 11.11, and 12.11.

4.2.2.5.1 Additional Requirements for New On-Ground or Underground Tanks [D-2a(5)]

The majority of the tanks and vessels to be constructed in the WTP will be located within the pretreatment plant, the LAW vitrification plant, and the HLW vitrification plant. Therefore, the requirements of this section do not apply to the indoor tanks.

The two outdoor process condensate tanks located at the pretreatment plant will be located within a bermed and lined secondary containment system and will not be in direct contact with soil. The design of the outdoor tanks' concrete pad will address backfill, soil saturation, seismic forces and freeze thaw effects. The ancillary piping for the unit will be in contact with the soil, and the effects of corrosion on the piping will be addressed in the final design.

4.2.2.6 Secondary Containment and Release Detection for Tank Systems [D-2b]

This section provides information about the secondary containment for tank systems that will contain mixed waste in the WTP. Descriptions of equipment and procedures used for detecting and managing releases or spills from tank systems are also provided.

4.2.2.6.1 Secondary Containment System Requirements [D-2b(1)]

Most of the tanks systems containing mixed waste will be located within the plants, although two tanks will be located outside the pretreatment plant. Tank systems containing mixed waste that are located within the plants will be arranged within various stainless steel-lined process cells, process rooms, or caves that will act as secondary containment. The outside tanks will be located on a concrete pad within concrete berms that will act as secondary containment.

The secondary containment systems will be designed, installed, and operated to prevent migration of waste or accumulated liquid to soil, groundwater or surface water. The piping associated with the tank systems will be located in the process cells, process rooms, caves, berms, or bulges. Secondary containment for piping systems will be incorporated into the design.

The following subsections provide detailed descriptions of typical secondary containment systems that will be used at the WTP.

Process Cells

Process cells will be located within process plants. Process cells will typically be constructed of concrete walls to protect plant operators and the environment from radiological exposure and to prevent migration of waste or accumulated liquid to soil, groundwater, or surface water. The process cells will house equipment and pipe-work designed to require little or no maintenance for the duration of the WTP. Operator access to the process cells will not be allowed during normal radioactive operations.

The process cell floors and portions of walls will be lined with stainless steel. The floor will be sloped to a collection sump to allow for collection and removal of accumulated liquid within the sump.

Process Rooms

Process rooms will be located in the LAW vitrification plant and will be very similar to process caves. Access to process rooms will not be allowed during normal radioactive operations. However, access will be allowed for certain areas within WTP for non-routine operations such as equipment replacement or maintenance. Process rooms will have a stainless steel liner on the floor and portions of the walls, and/or will be sealed with a protective coating. The LAW melter gallery area will have a protective coating on the concrete floor and walls. Systems within process rooms that manage mixed waste will have secondary containment (for example the locally shielded melter and piping).

Caves

Caves will be located within process plants. Caves will typically be constructed with concrete walls thick enough to protect personnel from radiological exposure. Caves will house mechanical handling equipment designed for remote operation and maintenance. They will generally have sealed lead glass viewing windows and closed circuit television to allow observation of the cave operations and for overseeing remote maintenance. The cave floors and portions of the walls will be lined with stainless steel. The floor of the cave will be sloped to a collection sump to allow for collection and removal of accumulated liquid within the sump.

Berms

Concrete berms will be used at the two outside pretreatment tanks. The berms will be of sufficient structural strength and height to contain the 100 percent of the volume of the largest tank plus the amount of precipitation that results from the 24-hour, 25-year storm event. A protective coating will be applied to the concrete pad and a portion of the berms to prevent contaminant penetration into the concrete. The containment system will be designed to allow for the discharge of storm water after visual or other testing.

Sump and Secondary Containment Drain Systems

The sump and secondary containment drain systems for the three process plants and the analytical laboratory are described in the following sections. Systems will monitor and collect liquids managed in the system. Sumps and secondary containment drains will be provided with a stainless steel liner or equivalent to act as the secondary containment. The sumps within the process areas will provide a low point for each secondary containment. Wash rings may be provided within some process areas for equipment, vessel, and cell washing and decontamination operations. The sumps will serve the following functions:

- Low point containment
- Removal of material by means of sump emptying ejectors or pumps
- Sampling of material by means of sump sampling ejectors

The following sections describe in detail the two types of sumps used at the WTP and the secondary containment drains. Tables 4-7 through 4-10 summarize WTP sump information by plant.

Type I Sumps

Mechanical process areas dealing with mechanical handling operations and containing dry material will be provided with Type I sumps. The sump and stainless steel lining will provide secondary containment for areas managing mixed waste. In addition, some LAW vitrification plant process rooms will be equipped with Type I sumps. The sump will provide a low point collection for the infrequent washing of machinery or the cave floor, for general cleanliness or decontamination prior to maintenance or deactivation. In some caves, these sumps will also collect leakage from effluent system transfer pipes associated with or passing through the cave. Type I sumps are generally fitted with a leak detection device with alarm. Their contents are removed using mechanical or fluidic pumps. A diagrammatic representation of this sump type is shown in Figure 4A-125.

Type II Sumps

These sumps will serve as the low point collection system for the stainless steel containment in a cell or mechanical cave where tank systems are present. The sump and stainless steel lining will provide secondary containment for the tanks and piping containing mixed waste. Type II sumps will be provided with a level detection and alarm device and a washout and emptying pump. Type II sumps are generally associated with a high radiation cell environment containing treatment tanks and piping. They are provided with maintenance-free fluidic emptying systems, such as ejectors or reverse flow diverters. These are wet sumps in which water will always be present to provide liquid level detection via a pneumacator and trigger high and low level alarms, if necessary. A diagrammatic representation of a cell sump is shown in Figure 4A-126.

It should be noted that a number of process pipe transfer duct drains will provide drainage back to a suitable cell or Type II sump. Waste pipes will be routed to various destinations within the plant. Some of these routes will require the use of concrete ducts, to provide radiation shielding and secondary containment coverage for the piping. The transfer ducts will be provided with stainless steel lining that drains to a low point within the duct, which will be drained to a suitable cell or wet mechanical sump to provide leak detection and sampling access. The transfer ducts will be provided with wash systems for area cleanup in the event of a pipe leak.

Secondary Containment Drains

Many of the bulges and some process rooms will have secondary containment drains with remotely-removable plugs. This type of liquid collection system will be located in a low spot in the cell formed by the sloping floor. Liquid detection instrumentation will be present on the top of a remotely removable plug. After the plug is removed, liquid collected will gravity-drain to a collection vessel with a tank level indicator. The liquid managed could be waste released from a tank system, including ancillary equipment, or water used to wash the exterior of tanks or the walls of the room. Liquid managed in the sump system could also be infrequently generated from the wash-down of cell walls or tank exteriors.

Design Requirements

The process cells, process rooms, or caves with mixed waste vessel or tank systems will be partially lined with stainless steel, which will cover the floor and extend up the sides of the process cell or cave to a height that can contain 100 percent of the volume from the largest tank within the process cell or cave. The height of the liners will not take into account fire suppression material, as the tanks will not manage ignitable waste. The concrete surfaces of the ceiling and the wall above the liner will be covered with a coating that is compatible with the waste feed to provide a splash shield zone. A sealant, compatible with the liner and the waste feed and wall coating, will be used to seal the liner-to-wall interface. Table 4-11 presents the calculated minimum liner height at the four process plants. Calculations for the liner size necessary in each cell and cave are available upon request.

A concrete berm with protective coating will be used for the pretreatment plant outdoor tanks. This secondary containment area will be capable of holding 100 percent of the volume from the largest tank within the berm, plus the precipitation from a 25-year, 24-hour rainfall event, as required under WAC 173-303-640(4)(e)(i)(B).

The WTP uses consensus-recognized standards to ensure that the process cells, process rooms, caves, or berms provide secondary containment with sufficient strength, thickness, and compatibility with waste. The design includes an engineered structural base to protect the cells, caves, berms and tank systems against failure resulting both from excess force applied during catastrophic events or settlement, and from the stress of daily operation. In the event of a spill or release, the structural and foundation design for tank and process cells, process rooms, caves and berms will prevent released mixed waste from reaching the environment, and will safely contain the waste until it can be transferred to an appropriate collection tank.

4.2.2.6.2 Management of Release or Spill to Sump and Secondary Containment Drain Systems [D-2b(1)]

Sumps collect vessel leakage, vessel overflow, and decontamination solutions used in cell and equipment wash down. The sump and cladding are provided to satisfy secondary containment requirements for vessels and piping containing liquid mixed waste. The WTP uses two types of sumps for different process conditions. If a cell has a personnel entrance and houses vessels, tanks, and piping that manage dangerous waste, a Type I, single lined sump is placed in the cell. If the cell is a non-accessible process cell and has welded piping, a Type II sump is utilized. In Type II sumps, water is always present, to ensure that sump level indicators are working. Additionally, water provides a ventilation seal that prevents airflow from entering vessel overflow piping when a vessel overflows to a sump. Wash rings allow for sump wash down.

Sumps have three level thresholds: high operational control; high level alarm; and cell high - high level alarm. When these level thresholds are reached, the process control system informs the operator to investigate the cause of the rising liquid level. The cell liners are sloped to direct flow of leaks, spills, or liner wash solutions to the sump. Process cell liners are made of stainless steel or equivalent material that satisfies regulatory requirements, and design life requirements. To remove liquid from the sumps in a timely fashion, sumps will be equipped with steam ejectors or pumps.

If a Type II sump is used, a small amount of water will be maintained in the sump during normal operating conditions. During normal operation, the water level will be maintained between the low and high operational controls. The operation control band limits will be set as close to each other as possible, and the alarm will be set above the high operational control to detect unusual level rises. The sump level will be constantly monitored. Typically, a moderate leak will generate a larger liquid volume than the amount of liquid that might be lost due to evaporation.

Abnormal rising of the liquid level in the sump will be investigated to determine its cause. In all cases, the cause for material in the sump will be determined. Mixed waste released from the primary system and collected in the sumps will be removed within 24 hours, or in as timely a manner as possible. If the released material cannot be removed within 24 hours, Ecology will be notified. After the sump content has been removed, the sump surfaces will be decontaminated using a wash-down system. Based on best management practices, a water flushing volume of approximately six sump volumes will be used to remove residual process water.

If a Type I sump is used, it will be equipped with a moisture probe to detect leakage. If liquid is detected in the Type I sump, similar procedures as described above for Type II sumps will be used to remove the content and decontaminate the sump surfaces.

If liquid is detected in the secondary containment drain, similar procedures to those described above for Type II sump will be used to remove drain contents and decontaminate drain surfaces.

4.2.2.6.3 Additional Requirements for Secondary Containment [D-2b(2)]

These requirements pertain to tanks in vault systems and double-walled tanks, which will not be used at the WTP. These requirements are not applicable at the WTP.

Ancillary equipment such as piping is addressed within Section 4.2.2. Other types of ancillary equipment such as pumps, seal pots, and reverse flow diverters, are either located in stainless-steel lined process rooms/cells or caves or are designed to provide their own secondary containment. Inspection of ancillary equipment is addressed in Chapter 6.

4.2.2.7 Variances from Secondary Containment Requirements [D-2b(2)(c)]

No variances from secondary containment requirements are sought for the WTP tank systems. Tank systems will be provided with secondary containment in the form of partially steel-lined or protectively coated process cells or rooms, caves and berms, as described in the previous sections.

4.2.2.8 Tank Management Practices [D-2d]

The following provides the basic philosophy for the WTP vessel overflow systems. Three types of barriers exist to prevent overfill of process equipment: preventive controls, detectors, and regulators. Preventive controls promote controlled filling within normal process ranges. Detectors recognize if a vessel is being overfilled and alert an operator. Lastly, if preventive controls and detectors fail to stop overfill from occurring, regulators trip a control sequence that stops inflow and/or initiates outflow. The principle design concept to control vessel overflow is to prevent an overflow from occurring. The engineering design will minimize the likelihood of tank, ancillary equipment, and containment system overflows, and over-pressurization, ruptures, leaks, corrosion, and other failures.

In general, overflows will be prevented by inventory control in conjunction with level monitoring. The fluid levels in a vessel will be maintained within low and high-level ranges. Appropriate alarm settings will be used to note deviations from the designed settings. Automatic trip action will be designed to shut down feed to the vessel when the high level settings are exceeded. These automatic trip actions will be provided for vessels with the potential for high operational and environmental impact in case of an accident or release.

Most of the WTP tank systems will be designed to incorporate minimal or zero maintenance requirements and will be based on a design life of approximately 40 years. Intrusively, the design emphasis of zero maintenance will minimize the likelihood of spills and overflows in the tank systems. In the event that the process controls fail to prohibit vessel overfilling, engineered overflows will be provided to prevent liquid from entering the vessel ventilation systems. Non-pressure vessels (nominally operating at atmospheric pressure) will have a suitable gravity or engineered overflow system, unless an overflow can be shown not to be possible. Vessels or systems that normally operate at above atmospheric pressures will not be provided with overflows.

The following principles apply when designing an engineered overflow system:

- The overflow system for vessels must be instantaneously and continuously available for use.
- Overflowed process streams must be returned to the waste treatment process.
- Overflow systems must meet the requirements of the WAC 173-303*, Dangerous Waste Regulations*, Section 640, Tank systems. In meeting these requirements, overflowing direct to the cell floor will only be considered as the last overflow in a cascaded system. Where an overflow is from a vessel to the cell, the overflow system will maintain segregation of the cell and vessel ventilation systems. The compatibility of the overflowing liquid and the recipient vessel will be considered.
- A vessel overflow line is sized to handle the maximum inflow to the vessel without the liquid level in the overflowing tank reaching an unacceptably high level. No valves or other restrictions are permitted in the overflow line. This line is also designed to prevent the buildup of material that could cause blockages.
- The overflow receiver is sufficiently sized to contain the overflow.
- Inspections will be performed on the various tank and overflow systems, using the example schedules described in Chapter 6.

4.2.2.9 Labels or Signs [D-2e]

Accessible tanks (i.e., the Pretreatment plant process condensate vessels, V45028A and V45028B) holding mixed waste will be labeled with stainless steel engraved nameplates. They will inform employees and emergency personnel of the types of waste present, warn of the identified risks, and provide other pertinent information.

4.2.2.10 Air Emissions [D-2f] and [D-8]

This section describes air emissions from vessel ventilation systems and reverse flow diverter exhausts. Organic emissions from vents associated with evaporator or distillation units are also discussed.

4.2.2.10.1 Tank System Emissions [D-2f]

Most of the tanks will be connected to a vessel ventilation system to collect vapors. Vessel vents will be located on major tanks, breakpots, and other small vessels. Exhaust from reverse flow diverters and pulse jet mixers will also be collected.

4.2.2.10.2 Process Vents [D-8a]

The air emission regulations, specified under WAC 173-303-690 and 40 CFR Part 264 Subpart AA, apply to process vents associated with distillation, fractionation, thin-film evaporation, and air or steam stripping operations that manage mixed waste with total organic carbon concentrations of at least 10 parts per million by weight. The WTP does not use these regulated processes, therefore this regulation does not apply to the WTP.

4.2.2.10.3 Equipment Leaks [D-8b]

Regulations provided in WAC 173-303-691 and 40 CFR Part 264 Subpart BB contain the "Air Emission Standards for Equipment Leaks." These air emission standards do not apply to the WTP because waste feed entering the WTP contains less than 10 percent total organic carbon by weight and is excluded under 40 CFR 264.1050(b).

4.2.2.10.4 Tanks and Containers [D-8c]

The regulations specified under WAC 173-303-692 and 40 CFR Part 264 Subpart CC do not apply to the WTP mixed waste tank systems and containers. These tanks and containers qualify as waste management units that are "used solely for the management of radioactive dangerous waste in accordance with applicable regulations under the authority of the Atomic Energy Act and the Nuclear Waste Policy Act" and are excluded under 40 CFR 264.1080(b)(6). Containers bearing nonradioactive, dangerous waste, such as maintenance and laboratory waste, that is not excluded under 40 CFR 264.1080 (b)(2) or 40 CFR 264.1080(b)(8), will comply with the tank and container standards specified under 40 CFR Part 264 Subpart CC.

4.2.2.11 Management of Ignitable, Reactive and Incompatible Waste in Tanks [D-2g] and [D-2h]

Mixed waste from the DST system unit will initially be designated as both ignitable (D001) and reactive (D003). The D001 and D003 waste numbers will be as described in the waste analysis plan in Appendix 3A. The vessels will be located in a manner that meets the National Fire Protection Association (NFPA) buffer zone requirements for vessels, as contained in Tables 2-1 through 2-6 of the *NFPA-30 Flammable and Combustible Liquids Code* (NFPA 1981). The vessels will be designed to store the waste in such a way that it will be protected from materials or conditions that could cause the contents to ignite or react. Vessel contents will be constantly mixed and will be actively vented to process stacks, which will be equipped with vapor collection and treatment systems that will manage emissions. Further information on waste numbers is contained in Appendix 3A.

Ignitable or reactive waste may be generated from laboratory or maintenance activities. This waste will be accumulated and managed in compliance with regulatory requirements, in approved containers. Potentially incompatible waste generated from laboratory or maintenance activities will not be stored in the tank systems.

A potential for incompatibility may exist, for example when nitric acid is used to elute waste components from ion-exchange column resins that were previously regenerated with sodium hydroxide. To minimize a reaction, water flushes will be performed between batches.

Process reagents that could react with waste in the tank systems will be stored in areas that are separated by physical barriers from process tanks. Potentially incompatible wastes generated from laboratory or maintenance activities will not be stored in proximity to each other in the tank systems.

4.2.3 Miscellaneous Units [WAC 173-303-680 and WAC 173-303-806(4)(i)]

This section describes LAW and HLW melter operations conducted at the WTP. The thermal treatment miscellaneous units will be melters and will be used to immobilize dangerous and radioactive waste constituents by vitrification. There will be three miscellaneous units in the LAW vitrification plant (LAW melters 1, 2, and 3) and one miscellaneous unit in the HLW vitrification plant (HLW melter).

4.2.3.1 Melter Capacity and Production

For the LAW melters, throughput is defined on the basis of quantity of glass waste produced. In turn, the quantity of glass waste produced depends on the degree to which the LAW feed can be incorporated into the glass waste matrix. The maximum design throughput of the LAW melter systems will be approximately 15 metric tons per day of glass waste for each melter and approximately 45 metric tons per day as maximum possible throughput for the LAW vitrification plant. The maximum operating production rate of the HLW melter is approximately 1.5 metric tons per day.

4.2.3.2 Description of Melter Units [WAC 173-303-806(4)(i)(i)]

The LAW melter systems are located in a melter gallery and the HLW melter is housed within a melter cave as shown in the general layout drawings, which are found in Appendix 4A. The following subsections provide detailed descriptions of the melter units.

<u>Low-Activity Waste Melter Unit</u>
The LAW melter is a rectangular furnace, lined with refractory material, with an outer steel casing. An additional outer steel casing with access panels will be provided to enclose the LAW melter. This outer steel casing is designed to provide local shielding and containment. Each melter has a nominal design capacity of approximately 10 to 15 metric tons of glass waste per day. Each will have a molten glass surface area of approximately 108 ft^2. Each of the three melters has external dimensions of approximately 26 × 19 × 16 ft high, and weighs approximately 450 metric tons empty, and 475 metric tons with glass. The operating temperature of the melter is between 950 °C and 1,250 °C.

The locally shielded LAW melter will be operated and maintained in a personnel access area. The melter will be maintained at a lower pressure than the surrounding room to prevent escape of contaminants. Consumable melter parts will be replaced through access panels. The melters will be transported in and out of the gallery on a rail system. A transporter will move the melters to and from the LAW vitrification plant.

The melter refractory package is designed to serve as a mechanical, thermal and electrical barrier between the molten glass residing in the melter and the melter shell.

The refractory package is housed in a steel shell and provides ultimate containment for the molten glass. Active cooling on the exterior of the melter is provided by water jackets. The water jackets will be in the intermediate loop of a two-loop system that will transfer heat from the LAW melter through heat exchangers to cooling towers. The intermediate loop containing the water jacket will be a closed system that isolates the water circulating through the water jacket from the water in the cooling water loop circulating to the cooling tower. Radioactive material leaking into the intermediate loop cooling water will be prevented from becoming an inadvertent discharge via the cooling tower. The refractory package will provide adequate containment if there is a temporary loss of cooling. Penetrations in the melter system are sealed using appropriate gaskets and flanges. This system is designed for plenum temperatures of up to 1,100 °C. The LAW melter lid is composed of steel and refractory material layers.

Each LAW melter will use two independent discharge chambers. An air lift pumps molten glass from the bottom of the melter pool, through a riser, into a discharge chamber, and poured into an ILAW container. The ILAW is then allowed to cool, forming a highly durable borosilicate glass waste form within the container.

Waste melters will initially be managed within the LAW locally shielded melter gallery containment building unit. Waste melters will be removed from the melter gallery and transported using a bogie transport and rail system. If necessary, the melter exterior surfaces will be decontaminated. The waste melters will be stored at the melter storage area 1 or 2 prior to disposal at a Hanford Site TSD.

<u>High-Level Waste Melter Unit</u>

The HLW melter is a rectangular furnace, lined with refractory material, with an outer steel casing. It has four compartments: glass tank, two discharge chambers, and a plenum just above the glass tank. The tank is lined with refractory material designed to withstand corrosion by molten glass.

The HLW melter system consists of one melter with the capability for a second melter. The HLW melter system has a nominal design capacity of 1.5 metric tons of glass waste per day and a maximum capacity of three metric tons per day. The operating temperature of the melter is between 950 °C and 1,250 °C. The HLW melter has a molten glass surface area of approximately 40 ft^2. The melter has external dimensions of approximately 12 × 15 × 12 ft. The glass contained in a full HLW melter has a volume of approximately 145 ft^3 and weighs approximately 9.1 metric ton. The entire melter, including the supporting structure and transport mechanism, weighs approximately 90 metric tons empty, and approximately 99 metric tons full.

The HLW melter has been designed to be remotely operated and maintained. Remote maintenance will be performed by power manipulator, overhead crane, and auxiliary hoist, or by through-wall master-slave manipulators. The melter will be positioned within the HLW vitrification plant for ease of access and viewing of both discharge chambers during operations, and for viewing access to the melter lid to facilitate removal and replacement of subcomponents, if needed. A rail and bogie transport system will facilitate remote removal and replacement of the entire melter structure.

The HLW melter will use a refractory package similar to the LAW melter to contain the molten glass. The refractory package is designed to serve as a mechanical, thermal and electrical barrier between the molten glass inside the melter and the melter shell.

The HLW melter will also use a steel outer shell, which, with the refractory package, will contain the molten glass and melter off-gas. Active cooling on the exterior of the melter will be provided by a water jacket, which will be in a two-loop system that will transfer heat from the HLW melter through heat exchangers to cooling towers. The loop containing the water jacket will be a closed system that isolates the water circulating through the water jacket from the water in the cooling water loop circulating to the cooling tower. Radioactive material leaking into the intermediate loop cooling water will be prevented from becoming an inadvertent discharge through the cooling tower. The refractory package will provide adequate containment should there be a loss of cooling. The HLW melter lid will be constructed of a steel outer shell and insulated from the melter plenum by refractory material.

The HLW melter will use two independent discharge chambers. Discharge will be achieved by transferring the molten glass from the bottom of the melter pool, through a riser, from which it will be poured into a stainless steel IHLW container. Glass waste transfer will be accomplished through air lifting. The IHLW will then be allowed to cool, forming a highly durable borosilicate glass waste form.

Waste melters will be removed from the melter cave and placed in an overpack. The spent melter will be treated as newly generated waste, and will initially be managed within the HLW melter containment building. If necessary, the overpack will be decontaminated using a dry process. Waste melters will be stored in the HLW or LAW out-of-service melter storage facility.

4.2.3.3 Automatic Waste Feed Cut Off System

The LAW and HLW melters will be equipped with the ability to cut off waste feed. Automatic waste feed cut off systems terminate feed to the melter if a specified operating condition is exceeded.

This design approach is consistent with the WAC 173-303-680 regulatory requirements.

The LAW and HLW melters are fed via air displacement slurry pumps that utilize pressurized air as the motive force. It supplies feed to the melters in slugs which act to keep lines from plugging. The feed is injected into the melters through the feed nozzles on top of the melter creating a "cold cap," where waste feed undergoes several physical and chemical changes. The glass product in the melter is then "air lifted" through the discharge chamber and into the glass container. Melter off-gas is generated from the vitrification of LAW and HLW of which the rate of generation is dynamic and not steady state. The off-gas is then carried away and treated via a dedicated off-gas system.

The melter systems are designed to minimize the need for automatic waste feed cut off functions. Control of melter level and plenum pressure, process alarming, and optimized operating procedures will be in place to reduce the occurrences of interlocking. Given the processing speeds and the relatively slow rates of change in the operating states of the melter, operations should have adequate time to react to upset conditions. An example of the slow rate of change can be seen in the volume of feed per air displacement slurry pump feed cycle when increasing melter level. Each pump cycle adds approximately one gallon of slurry into the melter. At one gallon of volume, the liquid level rises no greater than 0.01 in. inside the melter. This provides ample time for operator response.

Previous operating experience with similar melters has shown that two types of operating conditions existed that warranted automatic waste feed cut off: (1) high melter pressure, (2) high melter glass level. These interlocks have been sufficient to allow continued melter operations without inadvertent feed cut off signals, yet provide a sufficient safety margin.

4.2.3.4 Off-gas Treatment System

The off-gas treatment system will remove steam, aerosols, entrained particulates, decomposition products, and volatile contaminants that are generated from the vitrification processes and the vessel ventilation systems. The principle constituents contained in the melter off-gas stream are as follows:

- Air in-leakage and purges into the melter
- Water vapor evaporated from the melter feed
- Acid gases generated from anion decomposition (i.e., nitrogen oxide and sulfur oxide)
- Aerosols from dried melter feed and melter cold-cap reaction solids

A detailed description of the current off-gas treatment trains for the LAW and HLW melters is provided in Sections 4.1.4 and 4.1.5, respectively.

4.2.3.5 Maximum Achievable Control Technology (MACT) Standards

The WTP melter systems are thermal treatment units classified as miscellaneous units in Washington Administrative Code (WAC) 173-303-680. The dangerous waste regulations require that permits for miscellaneous units include such terms, conditions, and provisions that are necessary to protect human health and the environment and are appropriate for the miscellaneous unit being permitted. Ecology has determined that regulations that are most appropriate to apply to the melters and off-gas systems are found in applicable sections of the incinerator requirements (WAC 173-303-670). These standards are known as Maximum Achievable Control Technology (MACT) and were promulgated by the EPA in September 1999 (64 *FR* 52828). In April 2001, Ecology provided guidance to the WTP regarding the regulatory standards they will be applying to the melter systems, including certain requirements contained in the MACT rule for hazardous waste combustors (Ecology 2001). The requirements are outlined in the following:

Pollutant	**Ecology-directed requirement**
Principle Organic Dangerous Constituents	99.99% destruction and removal efficiency
Dioxins and Furans	0.20 ng TEQ/dscm
Mercury	45 µg/dscm
Lead and Cadmium	24 µg/dscm, combined emissions
Arsenic, Beryllium, Chromium	97 µg/dscm, combined emissions
Carbon Monoxide and Hydrocarbons	Carbon monoxide not in excess of 100 ppmv over an hourly rolling average, dry basis, and hydrocarbons not in excess of 10 ppmv over an hourly rolling average, dry basis, and reported as propane, at any time during the destruction and removal efficiency test runs or their equivalent, or hydrocarbons not in excess of 10 ppmv, over an hourly rolling average, dry basis, and reported as propane
Hydrochloric Acid and Chlorine Gas	21 ppmv, combined emissions, expressed as hydrochloric acid equivalents, dry basis
Particulate Matter	34 mg/dscm

- Emissions corrected to 7% oxygen basis
- TEQ is toxicity equivalence defined in 40 CFR 63.1201(a)
- dscm is dry standard cubic meter
- ppmv is parts per million by volume
- Rolling average is the average of all one minute averages over the averaging period [40 CFR 63.1202(a)]

On July 24, 2001, the United States Court of Appeals, District of Columbia (D.C.) Circuit, vacated the MACT rule for hazardous waste combustors and ordered the EPA to rewrite the emission standards (United States Court of Appeals, D.C. Circuit 2001a). On October 26, 2001, the EPA, together with other litigants, filed a joint motion asking the Court to delay issuance of a mandate that would vacate the MACT emission standards for hazardous waste combusters (United States Court of Appeals, D.C. Circuit 2001b). On November 1, 2001, the Court granted the joint motion. As a result, the mandate to vacate the emission standards has been stayed to February 14, 2002.

DOE intends that the melter systems be designed and constructed so that they operate in compliance with the appropriate and applicable standards. Environmental performance demonstrations during cold commissioning of the HLW and LAW vitrification plants will be used to verify compliance with the DRE and other as applicable air emission standards. Ecology's guidance also indicated that some periodic demonstration testing will need to be performed after the WTP has begun processing radioactive wastes (Ecology, 2001).

The WTP contractor has undertaken a review of the requirements outlined above to determine the feasibility of implementing them in a radioactive environment. A proposal regarding compliance with the MACT requirements will be prepared by the date identified in the DWPA Completion Schedule.

4.2.3.6 Physical and Chemical Characteristics of Waste [WAC 173-303-680(2)(a)(i)]

A description of the waste characteristics of the LAW and HLW feeds is presented in Chapter 3 (see Appendix 3A). The immobilized waste generated by the vitrification processes will be in the form of glass that maintains its chemical and physical integrity during long-term storage. The waste analysis plan (Appendix 3A) describes the types and frequency of analysis that will be performed on the glass waste.

4.2.3.7 Treatment Effectiveness Report [WAC 173-303-806(4)(i)(iv)]

A treatment effectiveness report evaluating the performance of the miscellaneous units, and their effectiveness in treating the LAW and HLW, is provided in Appendices 9.16 and 10.16. Sampling and analyses to be performed on the glass waste are described in the waste analysis plan (Appendix 3A). Air monitoring and analysis requirements are addressed in the WTP air permits.

4.2.3.8 Environmental Performance Standards for Melter Systems [WAC 173-303-680(2)]

An environmental performance demonstration will be conducted to demonstrate the efficiency of the LAW and HLW melter systems and their respective air pollution control systems. Emissions from the LAW and HLW systems will be sampled and analyzed during an environmental demonstration performed during cold commissioning. The data developed during the environmental performance demonstration will support the screening level risk assessment, which will support the development of environmental performance standards for the LAW and HLW melter systems.

The operational activities of the WTP include methods intended to ensure proper performance of equipment and processes. These methods include sampling of materials, use of direct process controls, development of equipment life specifications and ongoing maintenance.

4.2.3.8.1 Protection of Groundwater, Subsurface Environment, Surface Water, Wetlands and Soil Surface [WAC 173-303-680(2)(a) and (b)]

The LAW melters will be located in the LAW melter gallery within the LAW vitrification plant. The HLW melters will be located in the HLW melter caves within the HLW vitrification plant.

Both plants are designed to comply with standards that ensure protection of the surface and subsurface environments. The vitrification plants will be completely enclosed and are designed to have sufficient structural strength and corrosion protection to prevent collapse or other structural failure. In addition, the melter systems, melter feed systems, and related piping will be provided with secondary containment, to minimize the potential for release. The LAW melter gallery and the HLW melter caves will be permitted as containment buildings and are described in Section 4.2.4.

Floors within the vitrification plants will be protected in a manner consistent with the intended usage of the space. The process room floor and walls of the LAW melter gallery will be protectively coated. The floor and portions of the walls of HLW melter cave will be lined with stainless steel. Nonradioactive materials usage areas requiring heavy equipment will have concrete floors with hardener and sealer finishes.

The *Hanford Facility Dangerous Waste Permit Application General Information Portion*, Section 5.4 (DOE-RL 1998) provides climatological data, topography, hydrogeological and geological characteristics, groundwater flow quantity and direction, groundwater quality data, and surface water quantity and quality data for the area around the WTP.

4.2.3.8.2 Protection of the Atmosphere [WAC 173-303-680(2)(c)]

A risk assessment will be performed to evaluate the impacts of the WTP emissions on human and ecological receptors. Actual off-gas emissions will be measured during an environmental performance demonstration that will be performed as part of the WTP commissioning activities. The data will be used during a screening level risk assessment that will be performed to determine ecological and human health risk. The emissions data, and the results of the screening level risk assessment, will be used to establish operating conditions for the melters that do not endanger human health and the environment.

4.2.3.9 Approach to Risk Assessment [WAC 173-303-680(2) (c)(i) through (vii)]

A screening level risk assessment is being conducted to evaluate the environmental impacts posed by the thermal treatment of miscellaneous units. It will provide information about the potential pathways for exposure of human and ecological receptors to dangerous waste constituents. This risk assessment will present the methods, assumptions, and parameters that will be used to estimate the nature and magnitude of potential impacts from operation of the WTP, and will identify the guidance documents used in performing the risk assessment.

Treated air emissions through the stack will be the only planned direct releases into the environment from the WTP released directly into the environment. Other waste streams will be transferred to a permitted facility and will not be released directly into the environment. The screening level risk assessment will focus primarily on air emissions.

Major components of the risk assessment process for evaluating airborne emissions will be as follows:

- Risk assessment work plan
- Preliminary risk assessment
- Final risk assessment

The overall approach will be to identify potential risks associated with two exposure scenarios:

- Worst-case exposure scenario
- Plausible exposure scenario

The worst-case exposure scenario will be based on worst-case assumptions regarding the location of receptors, exposure pathways, and activity pattern. The plausible exposure scenario will be based on more realistic assumptions regarding the location of receptors. It will reflect current uses of the surrounding land and habitats, and reasonable assumptions about future uses of the land.

During the environmental performance demonstration, emission samples will be collected and analyzed, and the data will be used to evaluate risk to human and wildlife receptors. Operating conditions will be established for the WTP, which limit risks to human health and the environment to acceptable levels.

4.2.4 Containment Buildings

This section describes how these units are designed and operated, in accordance with the requirements of WAC 173-303-695, which incorporates 40 CFR Part 264 Subpart DD "Containment Buildings," by reference. Regulatory citations in this section list the applicable section of the CFR to make it easier for readers to find the requirement.

There will be twelve containment buildings at the WTP: three in the pretreatment plant; three in the LAW vitrification plant; and six in the HLW vitrification plant. The regulated units are:

- Pretreatment hot cell containment building
- Pretreatment maintenance containment building
- Pretreatment air filtration containment building
- LAW LSM gallery containment building
- ILAW container-finishing containment building
- LAW vitrification plant C3 workshop containment building
- HLW melter 1 and 2 containment buildings
- IHLW container weld containment building
- IHLW container decontamination building

- HLW vitrification plant C3 workshop containment building
- HLW vitrification plant air filtration containment building
- HLW vitrification plant drum transfer tunnel containment building

Table 4-12 summarizes the units within the WTP. The following figures found in Appendix 4A provide further detail for the WTP containment buildings:

- Typical system figure depicting common features for each containment building
- Simplified general arrangement figures showing locations of containment buildings
- Waste management area figures showing containment building locations to be permitted
- Contamination/radiation area boundary figures showing contamination/radiation zones throughout the plants

The following sections address each of the twelve containment buildings.

4.2.4.1 Pretreatment Hot Cell Containment Building

The first containment building in the pretreatment plant is located in the central portion of the pretreatment plant, and stretches nearly the entire length of the building.

The process equipment is remote handled in case of failure and is removed by an overhead crane or powered manipulator. Manipulators assist in the decontamination and remote repair. The unit also contains a crane and powered manipulator repair area. The failed equipment is placed inside disposal boxes and transported through a series of airlock and shield doors to a truck load out on the outside of the building.

Process equipment, such as pumps, valves, jumpers, and filters are located in this containment building. Typical waste management activities performed in this containment building include, the removal and staging of failed, remote-handled process equipment prior to decontamination, repair, and/or packaging of waste for disposal. Jumpers connecting process equipment may leak waste when the jumper connection is broken. Although some decontamination capability is present in the pretreatment hot cell containment building, some quantities of waste, especially solids, will remain following decontamination. The design features associated with the pretreatment hot cell containment building, discussed below, ensure the capability to manage residual waste from process jumper leakage throughout the 40-year design lifetime of the pretreatment plant.

Pretreatment Hot Cell Containment Building Design

The pretreatment hot cell containment building is designed as a completely enclosed area within the pretreatment plant. It is designed to prevent the release of dangerous constituents and their exposure to the outside environment. The design and construction of the hot cell, and the pretreatment plant exterior will prevent water from running into the plant. The approximate dimensions of the unit are summarized in Table 4-12.

Pretreatment Hot Cell Containment Building Structure

The pretreatment hot cell containment building will be a concrete-walled structure fully enclosed within the pretreatment plant. Therefore, structural requirements for the containment building will be met by the design standards of the pretreatment plant. The design will ensure that the unit has sufficient structural strength to prevent collapse or failure. The seismic requirements for the pretreatment plant are presented in the *RPP-WTP Compliance with Uniform Building Code Seismic Design Requirements* identified in Supplement 1.

Pretreatment Hot Cell Containment Building Materials

The pretreatment hot cell containment building will be constructed of steel-reinforced concrete. The interior floor and a portion of the walls of the unit will be lined with stainless steel. The balance of the walls will have an impervious coating. The roof of the pretreatment plant will consist of metal roofing, roof insulation, and vapor barrier. Rainwater run-off will be collected by roof drains and drainage systems with overflow roof drains.

Use of Incompatible Materials in the Pretreatment Hot Cell Containment Building

A stainless steel liner will be provided for this unit. Stainless steel will be compatible with the equipment waste that will be managed, which will include failed pumps, ultrafilters, and valves containing a minimal amount of waste constituents. Activities in the unit will include, but not be limited to decontamination, size reduction, and packaging the waste components into drums or waste boxes. Treatment reagents that could cause the liner to leak, corrode, or otherwise fail will not be used within the unit.

Primary Barrier Integrity in the Pretreatment Hot Cell Containment Building

The pretreatment hot cell containment building is designed to withstand loads from the movement of personnel, wastes, and handling equipment. The seismic design criteria identified in Supplement 1, ensures appropriate design loads, load combinations, and structural acceptance criteria are employed at the WTP.

Certification of Design for the Pretreatment Hot Cell Containment Building

Prior to startup of operations, a certification by a qualified registered professional engineer that the pretreatment hot cell containment building meets the design requirements of 40 CFR 264.1101(a), (b), and (c) will be obtained.

Operation of the Pretreatment Hot Cell Containment Building

Operational and maintenance controls and practices will be established and followed to ensure containment of the waste within the pretreatment hot cell containment building as required by 40 CFR 264.1101(c)(1).

Maintenance of the Pretreatment Hot Cell Containment Building

The stainless steel lining of the unit will be constructed and maintained in a manner that will be free of significant cracks, gaps, corrosion, or other deterioration. The stainless steel liner will remain free of corrosion or other deterioration because it is compatible with materials that will be managed in the containment building. The failed equipment that will be managed in the containment building unit will be compatible with stainless steel. Only decontamination chemicals that are compatible with the liner will be used.

Measures to Prevent Tracking Wastes from the Pretreatment Hot Cell Containment Building

The pretreatment hot cell containment building is designed to isolate failed equipment from the accessible environment and to prevent the spread of contaminated materials. Very little dust is expected to be generated in the unit. Personnel access to the unit, which is classified as a C5 contamination area, will be restricted due to radiological concerns. Waste leaving the unit may or may not be enclosed within containers. If necessary, these containers may be decontaminated in the unit prior to transportation to another permitted storage area. Equipment leaving the unit will be decontaminated before being released for removal.

Control of Fugitive Dust from the Pretreatment Hot Cell Containment Building

The following measures will be used to prevent fugitive dust from escaping the pretreatment hot cell containment building:

- A cascading air flow from areas of least to greatest potential contamination (i.e., C2 to C3 to C5)
- Greater negative air pressure in the unit compared to adjacent C2 units, to pull air into the unit and prevent backflow
- Intake air through controlled air in-bleed units, with backflow prevention dampers, and air gaps around shield doors sized to prevent backflow
- Dual HEPA filtration of exhaust air before discharge to the atmosphere through a monitored stack
- A multiple fan extraction system designed to maintain negative pressure and cascading air flow, even during fan maintenance and repair

Procedures in the Event of Release or Potential for Release from the Pretreatment Hot Cell Containment Building

The design and operation of the unit makes it very unlikely that releases will occur. The design and operational measures will minimize the generation of dust and contain it within the unit. The ventilation system will also use negative air pressure to keep contamination from areas of lesser contamination, and will use two-stage HEPA filtration to reduce the release of particles. The ventilation system is designed with backup HEPA filters to provide redundant controls and to facilitate repairs or replacement.

Inspections will identify conditions that could lead to a release. Such conditions will be corrected as soon as possible after they are identified. In the unlikely event that a release of dangerous wastes from the containment building is detected, actions required by 40 CFR 264.1101(c)(3)(i) through (iii) will be taken. Specific administrative and operating methods that will be used to satisfy this requirement will be developed prior to the start of operations. These methods will be followed to repair conditions that could lead to a release.

Inspections of the Pretreatment Hot Cell Containment Building

An inspection program will be established to detect conditions that could lead to a release of wastes from the pretreatment hot cell containment building. The inspection and monitoring schedule and methods that will be used to detect releases from the unit is included in Chapter 6.

4.2.4.2 Pretreatment Maintenance Containment Building

The pretreatment plant will have a second area that meets the definition of a containment building. The pretreatment maintenance containment building comprises the majority of the east end of the building. Typical waste management activities performed in this containment building include, equipment maintenance, including decontamination, size reduction, and packaging of spent equipment. This unit consists of the interim storage, lag storage, manipulator decontamination and repair, resin handling, waste packaging, tool cribs, sub-change, and filter overpack lidding rooms. The unit will include hatches to import or export spent equipment. An overhead crane will facilitate movement of equipment and removal or placement of the spent equipment in the waste containers.

Pretreatment Maintenance Containment Building Design

The pretreatment maintenance containment building is designed as a completely enclosed area within the pretreatment plant. The unit is designed to prevent the release and exposure of dangerous constituents to the outside environment. The design and construction of the pretreatment plant exterior will prevent water from running into the plant. The approximate dimensions of the unit are summarized in Table 4-12.

Pretreatment Maintenance Containment Building Structure

The pretreatment maintenance containment building will consist of several rooms within the concrete-walled, fully enclosed pretreatment plant. Therefore, structural requirements for the containment building will be met by the design standards of the pretreatment plant. The design will ensure that the unit has sufficient structural strength to prevent collapse or failure. The seismic requirements of the pretreatment plant are presented in the *RPP-WTP Compliance with Uniform Building Code Seismic Design Requirements,* as identified in Supplement 1.

Pretreatment Maintenance Containment Building Materials

The pretreatment maintenance containment building will be constructed of steel-reinforced concrete. The interior floor and portions of the walls of the unit will be lined with stainless steel. The balance of the walls will have an impervious coating. The roof of the pretreatment plant will consist of metal roofing, roof insulation, and a vapor barrier. Rainwater run-off will be collected by roof drains and drainage system with overflow roof drains.

Use of Incompatible Materials in the Pretreatment Maintenance Containment Building

A stainless steel liner will be provided for the unit. Stainless steel will be compatible with the equipment wastes that will be managed, which will include failed pumps, ultrafilters, and valves. Activities in the unit will be limited to decontamination, size reduction, and packaging the waste components into drums or waste boxes. Treatment reagents that could cause the liner to leak, corrode, or otherwise fail will not be used within the unit.

Primary Barrier Integrity in the Pretreatment Maintenance Containment Building

The pretreatment maintenance containment building is designed to withstand loads from the movement of personnel, wastes, and handling equipment. The seismic design criteria identified in Supplement 1, ensures appropriate design loads, load combinations, and structural acceptance criteria are employed at the WTP.

Certification of Design for the Pretreatment Maintenance Containment Building

Prior to startup of operations, certification by a qualified registered professional engineer that the pretreatment maintenance containment building meets the design requirements of 40 CFR 264.1101(a), (b), and (c) will be obtained.

Operation of the Pretreatment Maintenance Containment Building

Operational and maintenance controls and practices will be followed to ensure containment of the waste within the pretreatment maintenance containment building as required by 40 CFR 264.1101(c) (1).

Maintenance of the Pretreatment Maintenance Containment Building

The stainless steel lining of the unit will be constructed and maintained in a manner that will be free of significant cracks, gaps, corrosion, or other deterioration. The stainless steel liner will remain free of corrosion or other deterioration because it will be compatible with materials that will be managed in the containment building, which will include failed equipment. Only decontamination chemicals that are compatible with the liner will be used.

Measures to Prevent Tracking Wastes from the Pretreatment Maintenance Containment Building

The pretreatment maintenance containment building is designed to isolate failed equipment from the accessible environment and to prevent the spread of contaminated materials. A dust cleanup system will minimize the potential for dust to be tracked from the unit by humans or equipment. The containment building will be classified as a C3/C5 contamination area and, therefore, personnel access will be limited, and may be restricted due to radiological concerns. Wastes leaving the unit may be enclosed within containers. If necessary, these containers will be decontaminated in the unit prior to transportation to another permitted storage area. Equipment leaving the unit will be decontaminated before being released for removal from the cell.

Control of Fugitive Dust from the Pretreatment Maintenance Containment Building

The following measures will be used to prevent fugitive dust from escaping the pretreatment maintenance containment building.

- A cascading air flow from areas of least to greatest potential contamination (i.e., C2 to C3 to C5)
- Greater negative air pressure in the unit compared with adjacent C2 units, to pull air into the unit and prevent backflow
- Intake air through controlled air in-bleed units, with backflow prevention dampers, and air gaps around shield doors sized to prevent backflow

- Dual HEPA filtration of exhaust air before discharge to the atmosphere through a monitored stack
- A multiple fan extraction system designed to maintain negative pressure and cascading air flow, even during fan maintenance and repair
- Personnel ingress and egress through airlocks and subchange rooms

Procedures in the Event of a Release or Potential Release from the Pretreatment Maintenance Containment Building

The design and operation of the unit makes it very unlikely that releases will occur. The design and operational measures that will be used will minimize the generation of dust and contain it within the unit. The ventilation system will also use negative air pressure to keep contamination from areas of lesser contamination and will use two-stage HEPA filtration to reduce the release of particles.

Inspections will identify conditions that could lead to a release. Such conditions will be corrected as soon as possible after they are identified. The ventilation system is designed with backup HEPA filters to provide redundant controls and to facilitate repairs or replacement.

In the unlikely event that a release of dangerous wastes from the containment building is detected, actions required by 40 CFR 264.1101(c)(3)(i) through (iii) will be taken. Specific administrative and operating methods that will be used to satisfy this requirement will be developed prior to the start of operations. These methods will be followed to repair condition that could lead to a release.

Inspections of the Pretreatment Maintenance Containment Building

An inspection program will be established as required under WAC 173-303-695 to detect conditions that could lead to the release of wastes from the pretreatment maintenance containment building. The inspection and monitoring schedule and methods that will be used to detect a release is included in Chapter 6.

4.2.4.3 Pretreatment Air Filtration Containment Building

The pretreatment air filtration containment building is the third containment building within the pretreatment plant, in the southeast portion of the plant. Typical waste management activities performed in this containment building include, waste storage, size reduction, decontamination, and equipment repair. A crane transports spent HEPA and HEME filters to a size reduction station and then places them inside a disposal container. The disposal container is then transported via cart, through an air lock and shield doors and to a load out area for storage pending final disposal. The containment building also houses a hands-on crane decontamination and repair area.

Pretreatment Air Filtration Containment Building Design

The pretreatment air filtration containment building will be completely enclosed within the pretreatment plant, and will be designed to prevent the release and exposure of dangerous constituents to the outside environment. The design and construction of the pretreatment plant exterior will prevent water from running into the plant. The approximate dimensions of the containment building are summarized in Table 4-12.

Pretreatment Air Filtration Containment Building Structure

Because the pretreatment air filtration containment building will be a concrete-walled structure fully enclosed within the pretreatment plant, its requirements will be met by the design standards of the pretreatment plant. The design will ensure that the unit has sufficient structural strength to prevent collapse or failure. The seismic requirements for the pretreatment plant are presented in the *RPP-WTP Compliance with Uniform Building Code Seismic Design Requirements*, contained in Supplement 1.

Pretreatment Air Filtration Containment Building Materials

The pretreatment air filtration containment building will be constructed of steel-reinforced concrete. The interior floor and a portion of the walls will be lined with a protective coating. The roof of the pretreatment plant will consist of metal roofing, roof insulation, and a vapor barrier. Run-on will be collected by roof drains and a drainage system with overflow drains.

Use of Incompatible Materials for the Pretreatment Air Filtration Containment Building

A protective coating will be provided for the containment building. The coating will be compatible with the wastes that will be managed in the unit, which will include spent HEPA and HEME filters. Activities in the unit will be limited to size reduction and waste packaging. Treatment reagents that could cause the protective coating to leak, corrode, or otherwise fail will not be used within the unit.

Primary Barrier Integrity in the Pretreatment Air Filtration Containment Building

The pretreatment air filtration containment building will be designed to withstand loads from the movement of personnel, wastes, and handling equipment. The seismic design criteria found in Supplement 1, ensures appropriate design loads, load combinations, and structural acceptance criteria are employed at the WTP.

Certification of Design for the Pretreatment Air Filtration Containment Building

Prior to the start of operations, certification by a qualified registered professional engineer that the pretreatment air filtration containment building meets the design requirements of 40 CFR 264.1101(a) and (c) will be obtained. The requirements of 40 CFR 264.1101(b) do not apply to this design because waste containing liquids will not be managed in the unit and waste will not be treated with liquids.

Operation of the Pretreatment Air Filtration Containment Building

Operational and maintenance controls and practices will be established to ensure containment of the waste within the pretreatment air filtration containment building, as required by 40 CFR 264.1101(c)(1).

Maintenance of the Pretreatment Air Filtration Containment Building

The protectively-coated concrete floor and walls of the unit will be constructed and maintained in a manner that will be free of significant cracks, gaps, corrosion, or other deterioration. The protective coating will be compatible with materials that will be managed in the containment building, which will include spent HEPA and HEME filters. No decontamination chemicals that are incompatible with the coated concrete will be used.

Measures to Prevent Tracking Wastes from the Pretreatment Air Filtration Containment Building

The pretreatment air filtration containment building is designed to manage spent HEPA and HEME filters. Conducting these activities in a C5 zone will prevent the spread of contaminated materials. Restricted personnel access and controlled movement of equipment into and out of the unit will decrease the possibility that waste will be tracked from the unit.

Personnel access to the pretreatment plant air filtration containment building, which is classified as a C5 contamination area, will be restricted due to radiological concerns. Access to the unit will be allowed only under limited circumstances, thereby limiting the potential for contacting the waste and tracking it from the unit.

Control of Fugitive Dust from the Pretreatment Air Filtration Containment Building

The following measures will be used to prevent fugitive dust from escaping the pretreatment air filtration containment building unit:

- A cascading air flow from areas of least to greatest potential contamination (i.e., C2 to C3 to C5)
- Greater negative air pressure in the unit, compared with adjacent C2 units, to pull air into the unit and prevent backflow
- Intake air through controlled air in-bleed units, with backflow prevention dampers, and air gaps around shield doors sized to prevent backflow
- Dual HEPA filtration of exhaust air before discharge to the atmosphere through a monitored stack
- A multiple fan extraction system designed to maintain negative pressure, and cascading air flow, even during fan maintenance and repair
- Personnel ingress and egress through airlocks and subchange rooms

Procedures in the Event of Release or Potential for Release from the Pretreatment Air Filtration Containment Building

Conditions that could lead to a release from the Pretreatment air filtration containment building will be corrected as soon as possible after they are identified. The ventilation system and airlocks, the most likely sources of potential releases, will be designed with backup HEPA filters to facilitate repairs and replacement.

In the unlikely event of a release of dangerous wastes from the containment building, actions required by 40 CFR 264.1101(c)(3)(i) through (iii) will be taken. Specific administrative and operating methods that will be used to satisfy this requirement will be developed prior to the start of operations.

Inspections of the Pretreatment Air Filtration Containment Building

An inspection program will be established to detect conditions that could lead to a release of wastes from the Pretreatment air filtration containment building. The inspection and monitoring schedule, and methods that will be used to detect releases from the unit, are included in Chapter 6.

4.2.4.4 LAW LSM Gallery Containment Building

There will be three containment buildings in the LAW vitrification plant. The first is the LAW locally shielded melter (LSM) gallery containment building, which will house the three LAW melters. The melters are designed to include a roller or wheel assembly that will be used to move the melters in and out of the containment building. Out-of-service melters will be disconnected from the off-gas system, feed lines, electrical lines, and instrumentation. Open ports will be sealed. The sealed exterior of the melter will be decontaminated, if needed, prior to removal from the containment building. Out-of-service melters will be transported out of the unit to melter storage area 1 or 2.

LAW LSM Gallery Containment Building Design

The LAW LSM gallery containment building will be completely enclosed within the LAW vitrification plant. The unit will be designed to prevent the release and exposure of dangerous constituents to the outside environment. The design and construction of the LAW vitrification plant exterior will prevent water from running into the plant. The approximate dimensions of the unit are summarized in Table 4-12.

The melter feed slurry will be introduced to the LAW melters through single walled stainless steel feed lines. The feed lines will be provided with bulges that will function as secondary containment. A low point within the bulge will be incorporated into the design to allow drainage to a sump located in the adjacent process room.

The only other sources of liquids that will be present in the cave are the waterline to the two film cooler pipe washout spray rings, and the melter water jacket and connecting piping. These clean water lines will be instrumented to detect leaks automatically. A rupture of either water line or a waste feed line would be an abnormal event and the liquid would be contained within the outer melter shield box and corrective measures would be initiated. Corrective action would start with closure of the supply line and draining of remaining water outside the melter shield box, and could require feed cutoff and melter idling or shut down. The amount of water that could be released into the containment building would be unlikely to exceed a few gallons, which would rapidly evaporate into the ambient air due to the high temperature in the cave under normal operating conditions.

LAW LSM Gallery Containment Building Structure

The LAW LSM gallery containment building will be a concrete-walled structure fully enclosed within the LAW vitrification plant. Therefore, structural requirements for the containment building will be met by the design standards of the LAW vitrification plant. The design will ensure that the unit has sufficient structural strength to prevent collapse or failure. The seismic requirements for the LAW vitrification plant are presented in the *RPP-WTP Compliance with*

Uniform Building Code Seismic Design Requirements, found in Supplement 1. Within the containment building will be partitions between the LSMs.

LAW LSM Gallery Containment Building Materials

The LAW LSM gallery containment building will be constructed of steel-reinforced concrete. The interior floor and the walls of the unit will be covered with a protective coating. The roof of the LAW vitrification plant will consist of metal roofing, roof insulation, and a vapor barrier. Rainwater run-on will be collected by roof drains and a drainage system with overflow drains.

Use of Incompatible Materials for the LAW LSM Gallery Containment Building

A protective coating will be applied to the concrete floor and walls of the unit. The coating will be compatible with the wastes that will be managed in the containment building. The wastes to be managed will include LAW LSM melters and consumables, which may be metallic parts and failed equipment. Very little or no glass waste is expected to be present on the exterior of the LSM, due to the design of the melter. Reagents that could cause the liner to leak, corrode, or otherwise fail will not be used within the unit.

Primary Barrier Integrity in the LAW LSM Gallery Containment Building

The LAW LSM gallery containment building will be designed to withstand loads from the movement of personnel, wastes, and handling equipment. The seismic design criteria found in Supplement 1, ensures appropriate design loads, load combinations, and structural acceptance criteria are employed at the WTP.

Certification of Design for the LAW LSM Gallery Containment Building

Prior to the start of operations, certification by a qualified registered professional engineer that the LAW LSM gallery containment building meets the design requirements of 40 CFR 264.1101(a), (b), and (c) will be obtained.

Operation of the LAW LSM Gallery Containment Building

Operational and maintenance controls and practices will be established and followed to ensure containment of the waste within the LAW LSM gallery containment building, as required by 40 CFR 264.1101(c)(1). Activities in the building will be remotely-conducted.

Maintenance of the LAW LSM Gallery Containment Building

The protectively-coated concrete floor of the containment building will be constructed and maintained in a manner that will be free of significant cracks, gaps, corrosion, or other deterioration. The concrete and protective coating will be free of corrosion or other deterioration because it will be compatible with materials that will be managed in the containment building, including the glass waste and containerized or uncontainerized waste and equipment.

Measures to Prevent Tracking Wastes from the LAW LSM Gallery Containment Building

The unit is designed to manage LAW melters. The melters will be disconnected from systems when determined to be waste. The ports where the melter was attached to systems will be sealed and glass waste will be contained within the melter. This design will prevent waste from entering the containment building and thus from being tracked from the unit.

Personnel access will be limited due to radiological concerns. Access will be required only for non-routine events such as when melters are determined to be waste, once every four to five years, or when equipment must be dismantled. The unit will be classified as a C3 contamination area, which allows only limited personnel access. Dry decontamination methods using cloth will be used.

Control of Fugitive Dust from the LAW LSM Gallery Containment Building

Operational controls and the LAW vitrification plant ventilation system will be used to control fugitive dust emissions from the unit to meet the requirements of 40 CFR 264.11101(c)(1)(iv). The following measures will be used to prevent dust from escaping the LAW LSM gallery containment building:

- A cascading air flow from areas of least to greatest potential contamination (i.e., C2 to C3 to C5)
- Greater negative air pressure in the unit compared to adjacent C2 units, to pull air into the unit and prevent backflow
- Intake air through controlled air in-bleed units, with backflow prevention dampers, and air gaps around shield doors sized to prevent backflow
- Dual HEPA-filtration of exhaust air before discharge to the atmosphere through a monitored stack
- A multiple fan extraction system, designed to maintain negative pressure and cascading air flow, even during fan maintenance and repair
- Personnel ingress and egress through airlocks and subchange rooms

Procedures in the Event of Release or Potential for Release from the LAW LSM Gallery Containment Building

Conditions that could lead to a release from the LAW LSM gallery containment building will be corrected as soon as possible after they are identified. The ventilation system and airlocks, the most likely sources of potential releases, are designed with two stages of HEPA filters, with backup HEPA filters to facilitate repairs and replacement.

In the unlikely event of a release of dangerous wastes from the containment building, actions required by 40 CFR 264.1101(c)(3)(i) through (iii) will be taken. Specific administrative and operating methods that will be used to satisfy this requirement will be developed prior to the start of operations. The methods will be followed to repair conditions that could lead to a release.

Inspections of the LAW LSM Gallery Containment Building

An inspection program will be established to detect conditions that could lead to release of wastes from the LAW LSM gallery containment building. The inspection and monitoring schedule and methods that will be used to detect releases from the unit are included in Chapter 6.

4.2.4.5 ILAW Container-Finishing Line Containment Building

The ILAW containment building will be located in the LAW vitrification plant. It will be used for managing ILAW containers that have cooled sufficiently to be closed and prepared for finishing. Typical waste management activities perfromed in this containment buildign include, storage of uncontainerized waste, and decontamination. An ILAW container is transported from an inert filling room to a lidding room, to a decontamination room, and finally to a swab and monitor room, to a fixative application room as necessary, and then out of the containment building. This sequence of rooms is considered a finishing line. There are two finishing lines within the ILAW container finishing line containment building.

<u>ILAW Container-Finishing Containment Building Design</u>
The ILAW container-finishing containment building will be completely enclosed within the LAW vitrification plant. It will be designed to prevent the release and exposure of dangerous constituents to the outside environment. The design and construction of the LAW vitrification plant exterior will prevent water from running into the plant. The approximate dimensions of the unit are summarized in Table 4-12.

<u>ILAW Container-Finishing Containment Building Structure</u>
Because the ILAW container-finishing containment building will be a concrete-walled structure fully enclosed within the LAW vitrification plant, its structural requirements will be met by the design standards of the LAW vitrification plant. The design will ensure that the unit has sufficient structural strength to prevent collapse or failure. The seismic requirements for the LAW vitrification plant are presented in the *RPP-WTP Compliance with Uniform Building Code Seismic Design Requirements*, found in Supplement 1.

<u>ILAW Container-Finishing Containment Building Materials</u>
The ILAW container-finishing containment building will be constructed of steel-reinforced concrete. The primary barrier of the inert filling rooms, lid sealing rooms, and swab and monitor rooms is the concrete structure of the unit. The interior floor and a portion of the walls of the decontamination rooms will be lined with a protective coating.

The roof of the LAW vitrification plant will consist of metal roofing, roof insulation, and a vapor barrier. Roof drains and drainage system with overflow drains will collect run-on.

<u>Use of Incompatible Materials for the ILAW Container-Finishing Containment Building</u>
The primary barrier will have a protective coating. This coating will be compatible with the waste managed in the unit. The waste to be managed includes vitrified waste glass within the stainless steel containers. This coating will be present in the two inert fill rooms, the fixative application room, and the two swab and monitor rooms.

A protective coating will be present in the decontamination rooms. The coating will be compatible with the wastes that will be managed, which will include filled ILAW containers. No glass waste is expected to be present on the exterior of the containers, due to the design of the melter pour stations. The interior is the only portion of the container that will be exposed to the glass waste. Additionally, the removal of glass will occur in the inert fill rooms. Carbon dioxide pellets, also compatible with the stainless steel, will be used to remove contamination from the container surface.

Reagents that could cause the liner to leak, corrode, or otherwise fail will not be used within the unit.

Primary Barrier Integrity in the ILAW Container-Finishing Containment Building

The ILAW containment building will be designed to withstand loads from the movement of personnel, wastes, and handling equipment. The seismic design criteria found in Supplement 1, ensures appropriate design loads, load combinations, and structural acceptance criteria are employed at the WTP.

Certification of Design for the ILAW Container-Finishing Containment Building

Prior to start of operations, certification by a qualified registered professional engineer that the ILAW containment building meets the design requirements of 40 CFR 264.1101(a) and (c) will be obtained. The requirements of 40 CFR 264.1101(b) do not apply to this design because the waste managed in the unit will not contain free liquids and free liquids will not be used to treat the waste.

Operation of the ILAW Container-Finishing Containment Building

Operational and maintenance controls and practices will be established to ensure containment of the waste within the ILAW containment building, as required by 40 CFR 264.1101(c)(1). Activities in the building will be remotely conducted.

Maintenance of the ILAW Container-Finishing Containment Building

The protectively-coated concrete floor and walls of the of the containment building will be constructed and maintained in a manner that will be free of significant cracks, gaps, corrosion, or other deterioration. The coated concrete will be free of corrosion or other deterioration because it will be compatible with materials that will be managed in the containment building, which will include glass waste and containerized waste and equipment.

The protective coating in the decontamination rooms will be constructed and maintained in a manner that will be free of significant cracks, gaps, corrosion, or other deterioration. The coating will remain free of corrosion or other deterioration because it will be compatible with materials that will be managed in the containment building, which will include failed equipment. Wastes managed in the containment building will not be stacked.

Measures to Prevent Tracking Wastes from the ILAW Container-Finishing Containment Building

The ILAW containment building is designed to sample, seal, and decontaminate the filled ILAW containers. Conducting these activities in a C3 zone prevents the spread of contaminated materials from the unit as air flow is managed in the LAW vitrification plant ventilation system. The containment building is under negative pressure, so no air flow through doors or other openings occurs. Air flow through this containment building goes to a C5 air system, which passes through HEPA filters before exiting the plant stack.

A vacuum cleanup system, located in the two inert fill rooms, is expected to be infrequently used to collect dust from the inert filling activities, and thereby minimize the potential for dust to be tracked from the unit. The dust will be disposed of as secondary waste. Additionally, personnel access to the containment building, which is classified as a C3 contamination area, will be limited due to radiological concerns. Access to the unit will be allowed only under limited circumstances, reducing the potential for contacting the waste and tracking it from the unit.

Control of Fugitive Dust from the ILAW Container-Finishing Containment Building

The following measures will be used to prevent fugitive dust from escaping the containment building:

- A HEPA-filtered vacuum system will be dedicated to each decontamination room to collect debris
- A cascading air flow from areas of least to greatest potential contamination (i.e., C2 to C3 to C5)
- Greater negative air pressure in the unit, compared to adjacent C2 units, to pull air into the unit and prevent backflow
- Intake air through controlled air in-bleed units, with backflow prevention dampers, and air gaps around shield doors sized to prevent backflow
- Safety interlocks to shut down C3 extraction fans to prevent backflow if the C5 system shuts down
- Dual HEPA filtration of exhaust air before discharge to the atmosphere through a monitored stack
- A multiple fan extraction system, designed to maintain negative pressure and cascading air flow, even during fan maintenance and repair
- Personnel ingress and egress through airlocks and subchange rooms

Procedures in the Event of Release or Potential for Release from the ILAW Container-Finishing Containment Building

Conditions that could lead to a release from the ILAW containment building will be corrected as soon as possible after they are identified. The ventilation system and airlocks, the most likely sources of potential releases, will incorporate two stages of HEPA filters, with backup HEPA filters to facilitate repairs and replacement.

In the unlikely event of a release of dangerous wastes from the containment building, actions required by 40 CFR 264.1101(c)(3)(i) through (iii) will be taken. Specific administrative and operating methods to satisfy this requirement will be developed prior to the start of operations. The methods will be followed to repair conditions that could lead to a release.

Inspections of the ILAW Container-Finishing Containment Building

An inspection program will be established to detect conditions that could lead to a release of wastes from the ILAW container-finishing containment building. The inspection and monitoring schedule and methods that will be used to detect releases from the unit are included in Chapter 6.

4.2.4.6 LAW Vitrification Plant C3 Workshop Containment Building

The LAW vitrification plant C3 workshop containment building will be located in the northwestern portion of the LAW vitrification plant. Typical waste management activities performed in this containment building include, decontamination, size reduction and packaging of spent equipment. Simple decontamination of components will be performed to allow contact handling. Waste streams generated within the workshop will be volume reduced as necessary by means of disassembly or other suitable means to fit standard packaging such as drums and/or small boxes.

LAW Vitrification Plant C3 Workshop Containment Building Design

The LAW vitrification plant C3 workshop containment building will be designed as a completely enclosed area within the LAW vitrification plant. It is designed to prevent the release of dangerous constituents and their exposure to the outside environment. The design and construction of the LAW vitrification plant exterior will prevent water from running into the plant. The approximate dimensions of the unit are summarized in Table 4-12.

LAW Vitrification Plant C3 Workshop Containment Building Structure

The LAW vitrification plant C3 workshop containment building will be a concrete-walled structure fully enclosed within the LAW vitrification plant. Therefore, structural requirements for the containment building will be met by the design standards of the LAW vitrification plant. The design will ensure that the unit has sufficient structural strength to prevent collapse or failure. The seismic requirements for the LAW vitrification plant are presented in the *RPP-WTP Compliance with Uniform Building Code Seismic Design Requirements,* as found in Supplement 1.

LAW Vitrification Plant C3 Workshop Containment Building Materials

The LAW vitrification plant C3 workshop containment building will be constructed of steel-reinforced concrete. The interior floor and a portion of the walls of the unit will be lined with a protective coating. The roof of the LAW vitrification plant will consist of metal roofing, roof insulation, and vapor barrier. Rainwater run-off will be collected by roof drains and drainage systems with overflow roof drains.

Use of Incompatible Materials in the LAW Vitrification Plant C3 Workshop Containment Building

A protective coating will be provided for the floor of this unit. The protective coating will be compatible with the wastes that will be managed. Activities in the unit will be limited to decontamination, size reduction, and packaging the waste components into drums or waste boxes. Treatment reagents that could cause the liner or coating to leak, corrode, or otherwise fail will not be used within the unit.

Primary Barrier Integrity in the LAW Vitrification Plant C3 Workshop Containment Building

The LAW vitrification plant C3 workshop containment building will be designed to withstand loads from the movement of personnel, wastes, and handling equipment. The seismic design criteria found in Supplement 1, ensures appropriate design loads, load combinations, and structural acceptance criteria are employed at the WTP.

Certification of Design for the LAW Vitrification Plant C3 Workshop Containment Building

Prior to startup of operations, a certification by a qualified registered professional engineer that the LAW vitrification plant C3 workshop containment building meets the design requirements of 40 CFR 264.1101(a), (b), and (c) will be obtained.

Operation of the LAW Vitrification Plant C3 Workshop Containment Building

Operational and maintenance controls and practices will be established and followed to ensure containment of the wastes within the LAW vitrification plant C3 containment building unit as required by 40 CFR 264.1101(c)(1).

Maintenance of the LAW Vitrification Plant C3 Workshop Containment Building

The protective coating of the unit will be constructed and maintained in a manner that will be free of significant cracks, gaps, corrosion, or other deterioration. The protective coating will remain free of corrosion or other deterioration because it is compatible with materials that will be managed in the containment building. The failed equipment that will be managed in the containment building unit will be compatible with stainless steel or the protective coating. Only decontamination chemicals that are compatible with the liner or coating will be used.

Measures to Prevent Tracking Wastes from the LAW Vitrification Plant C3 Workshop Containment Building

The LAW vitrification plant C3 workshop containment building will be designed to isolate failed equipment from the accessible environment and to prevent the spread of contaminated materials. Very little dust is expected to be generated in the unit.

Personnel access to the containment building will be limited due to radiological concerns. It will be classified as a C3 contamination area, which allows only limited access by personnel. Wastes leaving the unit will be enclosed within containers. If necessary, these containers will be decontaminated in the unit and subjected to radiological survey prior to release and transportation to another permitted storage area. Equipment leaving the unit will be decontaminated, when necessary, before being released for removal from the cells.

Control of Fugitive Dust from the LAW Vitrification Plant C3 Workshop Containment Building

The following measures will be used to prevent fugitive dust from escaping the LAW vitrification plant C3 workshop containment building:

- A cascading air flow from areas of least to greatest potential contamination (that is, C2 to C3 to C5)
- Intake air through controlled air in-bleed units, with backflow prevention dampers, and air gaps around shield doors sized to prevent backflow

- HEPA filtration of exhaust air before discharge to the atmosphere through a monitored stack
- A multiple fan extraction system designed to maintain negative pressure and cascading air flow, even during fan maintenance and repair

Procedures in the Event of Release or Potential for Release from the LAW Vitrification Plant C3 Workshop Containment Building

The design and operation of the unit makes it very unlikely that releases will occur. The design and operational measures will minimize the generation of dust and contain it within the unit. The ventilation system will also use negative air pressure to keep contamination from areas of lesser contamination, and will use two-stage HEPA filtration to reduce the release of particles. The ventilation system is designed with backup HEPA filters to provide redundant controls and to facilitate repairs or replacement.

Inspections will identify conditions that could lead to a release. S uch conditions will be corrected as soon as possible after they are identified. In the unlikely event that a release of dangerous wastes from the containment building is detected, actions required by 40 CFR 264.1101(c)(3)(i) through (iii) will be taken. Specific administrative and operating methods that will be used to satisfy this requirement will be developed prior to the start of operations. These methods will be followed to repair conditions that could lead to a release.

Inspections of the LAW Vitrification Plant C3 Workshop Containment Building

An inspection program will be established to detect conditions that could lead to a release of wastes from the LAW vitrification plant C3 workshop containment building. The inspection and monitoring schedule and methods that will be used to detect releases from the unit is included in Chapter 6.

4.2.4.7 HLW Melter 1 and 2 Containment Buildings

There are six containment buildings located within the HLW vitrification plant. The HLW melter 1 and 2 containment buildings are located in the central portion of the HLW vitrification plant. The containment buildings will be comprised of the HLW melter caves and the C3/C5 airlocks.

Typical waste management activities performed in these containment buildings include, the dismantling and packaging of spent consumables, and decontamination. The types of spent consumables will include waste recirculators, lid heaters, and thermocouples. When spent consumables are ready for change-out, they will be placed on a consumable storage rack while awaiting size reduction. The consumables will be reduced in size by dismantling or cutting the spent equipment, or both. This process will be remotely-conducted on tables in the containment building. The spent consumables will be placed in baskets and lowered into containers in a transfer tunnel that passes under the HLW melter 1 and 2 containment buildings. The airlock cells will be used for packing or unpacking melters or their components.

In case of a HLW melter failure, the melter will be evaluated for meeting the receiving TSD waste acceptance criteria, particularly in terms of the radiological contamination in the HLW glass residue present in the melter, before it is placed in an overpack.

Located within the melter caves will be the HLW melter; the submerged bed scrubber, which will function as part of the melter off-gas system; the feed preparation tank; and the feed tank. These tank systems will have primary and secondary containment, and are addressed Section 4.2.2. Therefore, there is no need for secondary containment within the containment building, as the tank systems meet the requirements WAC 173-303-640.

HLW Melter 1 and 2 Containment Building Design

The HLW melter containment buildings are completely enclosed within the HLW vitrification plant. Each unit will comprise the HLW melter cave and the overpack C3/C5 airlock cell. Each unit is designed to prevent the release of dangerous constituents and exposure to the outside environment. The design and construction of the HLW vitrification plant exterior will prevent water from running into the plant.

The only other sources of liquids that will be present in the caves is the water line to the two film cooler pipe washout spray rings, and the melter water jacket and connecting piping. These clean water lines will be instrumented to detect leaks automatically. A rupture of either water line would be an abnormal event and would require corrective measures. Corrective action would start with closure of the supply line and draining of remaining water outside the caves, and could require feed cutoff and melter idling or shut down. The amount of water that could be released in the containment building would be unlikely to exceed a few gallons, which would rapidly evaporate into the ambient air due to the high temperature in the caves under normal operating conditions.

The containment building design requirements of 40 CFR 264.1101(b) do not apply because the liquid wastes managed in the HLW melter containment building are addressed under tank systems (see Section 4.2.2).

HLW Melter 1 and 2 Containment Building Structure

The HLW melter 1 and 2 containment buildings will be a fully enclosed, concrete-walled structure within the HLW vitrification plant. Therefore, its structural requirements will be met by the design standards of the HLW vitrification plant. The design will ensure that the unit has sufficient structural strength to prevent collapse or failure. The seismic requirements for the HLW vitrification plant are found in the *RPP-WTP Compliance with Uniform Building Code Seismic Design Requirements*, found in Supplement 1.

HLW Melter 1 and 2 Containment Building Materials

The HLW melter 1 and 2 containment building will be constructed of steel-reinforced concrete. The interior floor and a portion of the walls of the unit will be lined with stainless steel. The height of the lining is summarized in Table 4-11.

The roof of the HLW vitrification plant will consist of metal roofing, roof insulation, and a vapor barrier. Run-off will be collected by roof drains and a drainage system with overflow roof drains.

Use of Incompatible Materials for the HLW Melter 1 and 2 Containment Buildings

A stainless steel liner will be provided for the containment buildings. The stainless steel will be compatible with the wastes that will be managed, which will include failed melters and consumables, including air spargers, metallic parts and refractory bricks. Treatment reagents that could cause the liner to leak, corrode, or otherwise fail will not be used within the unit.

Primary Barrier Integrity in the HLW Melter 1 and 2 Containment Buildings

The HLW melter 1 and 2 containment buildings are designed to withstand loads from the movement of personnel, wastes, and handling equipment. The seismic design criteria found in Supplement 1, ensures appropriate design loads, load combinations, and structural acceptance criteria are employed at the WTP.

Certification of Design for the HLW Melter 1 and 2 Containment Buildings

Prior to the start of operations, certification by a qualified registered professional engineer that the HLW melter containment building meets the design requirements of 40 CFR 264.1101(a) and (c) will be obtained. The requirements of 40 CFR 264.1101(b) do not apply to this design because liquid wastes present in the containment building will be managed in tank systems with secondary containment systems, as presented in Section 4.2.2.

Operation of the HLW Melter 1 and 2 Containment Buildings

Operational and maintenance controls and practices will be established and followed to ensure containment of the wastes within the HLW melter containment building, as required by 40 CFR 264.1101(c)(1).

Maintenance of the HLW Melter 1 and 2 Containment Buildings

The stainless steel lining of the containment building will be constructed and maintained in a manner that will be free of significant cracks, gaps, corrosion, or other deterioration. The liner will be welded at each seam. The stainless steel liner will be free of corrosion or other deterioration because it will be compatible with materials that will be managed in the containment building, which will include failed melters and spent equipment. Only decontamination chemicals that are compatible with the liner will be used.

Wastes managed in the containment building will not be stacked. In general, waste will be placed in containers and removed from the containment building.

Measures to Prevent Tracking Wastes from the HLW Melter 1 and 2 Containment Building

The HLW melter containment building design and operating methods include several measures that will prevent wastes from being tracked from the unit. Measures that will be implemented include:

- Limiting the movement of personnel and material from the unit

- Using interlocked shield doors to prevent the inadvertent spread of contamination
- Decontamination of materials or containers before they are released from the unit

Personnel access to the HLW melter caves, which are classified as a C5 contamination area, will be restricted due to radiological concerns. Personnel operating in melter cave C3/C5 airlocks will not be in contact with failed melters because they will be encased in overpack containers

Export of equipment from the melter caves will be kept to a minimum by performing in-cave maintenance to the maximum extent possible. The design of the cave and equipment includes master-slave manipulators, special tools, and a tool import port that will enable maintenance operations to be conducted remotely without removing the equipment from the cave. When equipment must be removed for hands-on maintenance, it will be transferred through shield doors into the crane decontamination area (C3/C5) above the C3/C5 airlock. The C3/C5 doors will be interlocked with shield doors to the adjacent maintenance room, to prevent radiological shine and the spread of contamination. The equipment will be transferred to the maintenance room only after it has been decontaminated.

Spent consumables and wastes will be size-reduced in the cave and exported to drums through an air lock, which is designed to provide containment of contamination between the C5 melter cave and the C3 drum transfer tunnel. Export of failed melters will be controlled to prevent the spread of contamination. Melters will be transferred into overpack containers that are docked with the shield doors to the C3/C5 airlock.

<u>Control of Fugitive Dust from the HLW Melter 1 and 2 Containment Buildings</u>
Operational controls and the HLW vitrification plant ventilation system will be used to control fugitive dust emissions from the unit to meet the requirements of 40 CFR 264.11101(c)(1)(iv). The following measures will be used to prevent dust from escaping the HLW melter 1 and 2 containment buildings:

- A cascading air flow from areas of least to greatest potential contamination (i.e., C2 to C3 to C5)
- Greater negative air pressure in the unit, compared with adjacent C3 units, to pull air into the unit and prevent backflow
- Intake air through controlled air in-bleed units, with backflow prevention dampers
- Dual HEPA filtration of exhaust air before discharge to the atmosphere through a monitored stack
- A multiple fan extraction system, designed to maintain negative pressure and cascading air flow, even during fan maintenance and repair
- Personnel ingress and egress through airlocks and subchange rooms

Procedures in the Event of Release or Potential for Release from the HLW Melter 1 and 2 Containment Buildings

Conditions that could lead to a release from the HLW melter 1 and 2 containment buildings will be corrected as soon as possible after they are identified. The ventilation system and airlocks, the most likely sources of potential releases, are designed with backup HEPA filters to facilitate repairs and replacement.

In the unlikely event of a release of dangerous wastes from either containment building, actions required by 40 CFR 264.1101(c)(3)(i) through (iii) will be taken. Specific administrative and operating methods to satisfy this requirement will be developed prior to the start of operations.

Inspections of the HLW Melter 1 and 2 Containment Buildings

An inspection program will be established, as required under WAC 173-303-695, to detect conditions that could lead to the release of wastes from the HLW melter 1 and 2 containment buildings. The inspection and monitoring schedule and methods that will be used to detect a release from the unit are included in Chapter 6.

4.2.4.8 IHLW Container Weld Containment Building

The IHLW container weld containment building will be located in the southern portion of the HLW vitrification plant. Typical waste management activities performed within this containment building include the storage of uncontainerized waste. Located within the containment building will be two cooling and buffer storage areas and two container welding and rework stations. IHLW containers, which have cooled enough to leave the miscellaneous unit pour areas, will be transported to the IHLW container weld containment building by means of an overhead crane. The IHLW glass waste will continue to cool in the buffer storage areas. When adequately cooled, containers will be moved to one of the two weld and rework cells, where the temporary lid that had been placed on the container will be removed and the permanent lid will be welded onto the container. The IHLW container will then be transported to the IHLW container decontamination containment building. Container management practices are discussed in Section 4.2.1.

IHLW Container Weld Containment Building Design

The container weld containment building will be completely enclosed within the HLW vitrification plant. The design and construction of the HLW vitrification plant exterior will prevent water from running into the plant. The unit is designed to prevent the release and exposure of dangerous constituents to the outside environment. Its approximate dimensions are summarized in Table 4-12.

IHLW Container Weld Containment Building Structure

Because the container weld containment building will be a concrete-walled structure fully enclosed within the HLW vitrification plant, its structural requirements will be met by the design standards of the HLW vitrification plant. The design will ensure that the unit has sufficient structural strength to prevent collapse or failure. The seismic requirements for the structure are addressed in the *RPP-WTP Compliance with Uniform Building Code Seismic Design Requirements*, found in Supplement 1.

IHLW Container Weld Containment Building Unit Materials
The container weld containment building will be constructed of steel-reinforced concrete. The interior floor and a portion of the walls of the unit will be lined with stainless steel. The height of the lining will be determined as design progresses. The roof of the HLW vitrification plant will be metal. Run-off will be collected by roof drains and a drainage system with overflow roof drains.

Use of Incompatible Materials for the IHLW Container Weld Containment Building
A stainless steel liner will be provided for the containment building which will be compatible with the IHLW steel containers that will be managed. Treatment reagents that could cause the liner to leak, corrode, or otherwise fail will not be used in the unit.

Primary Barrier Integrity in the IHLW Container Weld Containment Building
The HLW vitrification plant is designed to withstand loads from the movement of personnel, wastes, and handling equipment. The seismic design criteria found in Supplement 1, ensures appropriate design loads, load combinations, and structural acceptance criteria are employed at the WTP.

Certification of Design for the IHLW Container Weld Containment Building
Prior to the start of operations, certification by a qualified registered professional engineer that the IHLW container weld containment building meets the design requirements of 40 CFR 264.1101(a) and (c) will be obtained. The requirements of 40 CFR 264.1101(b) do not apply to this design because waste containing free liquid wastes will not be managed in the containment building and the waste will not be treated with free liquids.

Operation of the IHLW Container Weld Containment Building
Operational and maintenance controls and practices will be established to ensure containment of the wastes within the IHLW container weld containment building, as required by 40 CFR 264.1101(c)(1).

Maintenance of the IHLW Container Weld Containment Building
The stainless steel lining of the containment building will be constructed and maintained in a manner that will be free of significant cracks, gaps, corrosion, or other deterioration. The stainless steel liner will be welded at each seam, and will be free of corrosion or other deterioration because it will be compatible with materials that will be managed in the containment building, including the stainless steel containers. Only decontamination chemicals that are compatible with the liner will be used.

Wastes that will be managed in the containment building will not be stacked higher than unit wall, however, wastes are not anticipated to be stacked.

Measures to Prevent Tracking Wastes from the IHLW Container Weld Containment Building
The IHLW container weld containment building is designed to store cooling IHLW glass waste containers and weld the lids onto the containers.

The outside of the container will be inspected to see whether glass is present on the container. If glass is found, it will be removed using a needle gun or other mechanical method. The glass shards will be collected for disposal in a shop-type vacuum and disposed of as a secondary waste. The containment building will be classified as a C5 contamination area, and therefore personnel access will be limited due to radiological concerns. Wastes leaving the unit will be within containers.

Control of Fugitive Dust from the IHLW Container Weld Containment Building

Operational controls and the HLW vitrification plant ventilation system will be used to control fugitive dust emissions from the unit to meet the requirements of 40 CFR 264.11101(c)(1)(iv). The following measures will be used to prevent dust from escaping the IHLW container weld containment building:

- A cascading air flow from areas of least to greatest potential contamination (i.e., C2 to C3 to C5)
- Greater negative air pressure in the unit compared with adjacent C3 units, to pull air into the unit and prevent backflow
- Intake air through controlled air in-bleed units, with backflow prevention dampers
- Dual HEPA filtration of exhaust air before discharge to the atmosphere through a monitored stack
- A multiple fan extraction system, designed to maintain negative pressure and cascading air flow, even during fan maintenance and repair
- Personnel ingress and egress through airlocks and subchange rooms

Procedures in the Event of Release or Potential for Release from the IHLW Container Weld Containment Building

Conditions that could lead to a release from the IHLW container weld containment building will be corrected as soon as possible after they are identified. The ventilation system, as the most likely source of potential releases, is designed with backup HEPA filters to facilitate repairs and replacement.

In the unlikely event of a release of dangerous wastes from the containment building, actions required by 40 CFR 264.1101(c)(3)(i) through (iii) will be taken. Specific administrative and operating methods to satisfy this requirement will be developed prior to the start of operations.

Inspections of the IHLW Container Weld Containment Building

An inspection program will be established as required under WAC 173-303-695 to detect conditions that could lead to the release of wastes from the IHLW container weld containment building. The inspection and monitoring schedule and methods that will be used to detect a release from the unit are included in Chapter 6.

4.2.4.9 IHLW Container Decontamination Containment Building

The IHLW container decontamination building will be located in the southeast corner of the HLW vitrification plant. Typical waste management activities performed in this containment building include decontamination of the exterior of the filled IHLW containers.

IHLW containers, which have permanent lids, will be received at the unit. The containers will be washed in a tank with de-ionized water to remove loose contamination that may be on the surface of the container. The container will then be washed with ceric nitrate and nitric acid to remove a layer of steel as part of the decontamination process. The tank will be drained and the container will then be sprayed with nitric acid. Additional nitric acid rinses may be conducted, if needed. A deionized water spray will then be performed. Tank activities will occur in permitted tank systems which have secondary containment, as addressed in Section 4.2.2.

After the decontaminated container has dried it will be transferred to the swabbing station, where its exterior will be swabbed, and the swabs monitored for gamma radiation. When the container is found to meet surface radiological requirements, it will be transferred to the IHLW container storage area.

<u>IHLW Container Decontamination Containment Building Design</u>
The IHLW container decontamination building will be completely enclosed within the HLW vitrification plant, and will be designed to prevent the release of dangerous constituents and their exposure to the outside environment. The design and construction of the HLW vitrification plant exterior will prevent water from running into the plant. Unit dimensions are summarized in Table 4-12.

The containment building design requirements of 40 CFR 264.1101(b) do not apply because the liquid wastes managed in the IHLW container decontamination containment building are addressed under tank systems in Section 4.2.2.

<u>IHLW Container Decontamination Containment Building Structure</u>
Because the IHLW container decontamination building will be a concrete-walled structure fully enclosed within the HLW vitrification plant, its structural requirements will be met by the design standards of the HLW vitrification plant. The design will ensure that the unit has sufficient structural strength to prevent collapse or failure. The seismic requirements that the building must address are presented in the *RPP-WTP Compliance with Uniform Building Code Seismic Design Requirements*, found in Supplement 1.

<u>IHLW Container Decontamination Containment Building Unit Materials</u>
The IHLW container decontamination containment building will be constructed of steel-reinforced concrete. The interior floor and a portion of the walls of the unit will be lined with stainless steel. The roof of the HLW vitrification plant will consist of metal roofing, roof insulation, and a vapor barrier. Run-off will be collected by roof drains and a drainage system with overflow roof drains.

<u>Use of Incompatible Materials for the IHLW Container Decontamination Containment Building</u>

A stainless steel liner will be provided for the containment building and will be compatible with the IHLW containerized wastes that will be managed. Treatment reagents that could cause the liner to leak, corrode, or otherwise fail will not be used within the unit.

<u>Primary Barrier Integrity in the IHLW Container Decontamination Containment Building</u>

The IHLW container decontamination building is designed to withstand loads from the movement of personnel, wastes, and handling equipment. The seismic design criteria found in Supplement 1, ensures appropriate design loads, load combinations, and structural acceptance criteria are employed at the WTP.

<u>Certification of Design for the IHLW Container Decontamination Containment Building</u>

Prior to the start of operations, certification by a qualified registered professional engineer that the IHLW container decontamination containment building meets the design requirements of 40 CFR 264.1101(a) and (c) will be obtained. The requirements of 40 CFR 264.1101(b) do not apply to this design because free liquids managed in the unit are addressed under tank systems in Section 4.2.2.

<u>Operation of the IHLW Container Decontamination Containment Building</u>

Operational and maintenance controls and practices will be established to ensure containment of the wastes within the IHLW container decontamination containment building, as required by 40 CFR 264.1101(c)(1).

<u>Maintenance of the IHLW Container Decontamination Containment Building</u>

The stainless steel lining of the containment building will be constructed and maintained in a manner that will be free of significant cracks, gaps, corrosion, or other deterioration. The stainless steel liner will be welded at each seam, and will be free of corrosion or other deterioration because it will be compatible with materials that will be managed in the containment building, as well as the stainless steel containers that will be managed. Only decontamination chemicals that are compatible with the liner will be used. Wastes are not expected to be stacked within the unit.

<u>Measures to Prevent Tracking Wastes from the IHLW Container Decontamination Containment Building</u>

The IHLW decontamination containment building is designed to manage containers which undergo decontamination in tank systems and to swab the containers to determine whether decontamination has been effective. The containment building will be a C5 area. Conducting these activities in a C5 zone will prevent the spread of contaminated materials. The containment building is under negative pressure and therefore no air particulates can escape the unit. The air from the unit passes through HEPA filtration prior to discharge out of the plant stack.

Personnel access to the IHLW container decontamination containment building, which is classified as a C5 contamination area, will be limited due to radiological concerns. Therefore, personnel moving into and out of the unit will not track contamination out of the unit.

Control of Fugitive Dust from the IHLW Container Decontamination Containment Building

Operational controls and the HLW vitrification plant ventilation system will be used to control fugitive dust emissions from the unit to meet the requirements of 40 CFR 264.11101(c)(1)(iv). The following measures will be used to prevent fugitive dust from escaping the IHLW container decontamination containment building.

- A cascading air flow from areas of least to greatest potential contamination (i.e., C2 to C3 to C5)
- Greater negative air pressure in the unit, compared to adjacent C3 units, to pull air into the unit and prevent backflow
- Intake air through controlled air in-bleed units with backflow prevention dampers
- Safety interlocks to shut down C3 extract fans to prevent backflow if the C5 system shuts down
- Dual HEPA filtration of exhaust air before discharge to the atmosphere through a monitored stack
- A multiple fan extraction system, designed to maintain negative pressure and cascading air flow, even during fan maintenance and repair
- Personnel ingress and egress through airlocks and subchange rooms

Procedures in the Event of Release or Potential for Release from the IHLW Container Decontamination Containment Building

Conditions that could lead to a release from the container decontamination building will be corrected as soon as possible after they are identified. The ventilation system, the most likely source of potential releases, is designed with two stages of HEPA filters with backup HEPA filters to facilitate repairs and replacement.

In the unlikely event of a release of dangerous wastes from the containment building, actions required by 40 CFR 264.1101(c)(3)(i) through (iii) will be taken. Administrative and operating methods to satisfy this requirement will be developed prior to the start of operations.

Inspections of the IHLW Container Decontamination Containment Building

An inspection program will be established as required under WAC 173-303-695, to detect conditions that could lead to release of wastes from the IHLW container decontamination containment building. The inspection and monitoring schedule and methods that will be used to detect a release is included in Chapter 6.

4.2.4.10 HLW Vitrification Plant C3 Workshop Containment Building

The HLW vitrification plant C3 workshop containment building will be located in the northeast side of the HLW vitrification plant.

Typical waste management activities performed in this containment building include, decontamination, size reduction, and packaging of spent equipment. Equipment will be transported to the unit contained in shielded casks or in a standard waste box. In the workshop, the equipment will be decontaminated to enable "hands on" maintenance. Spent equipment parts will be bagged and placed in standard waste containers or boxes for disposal. Size reduction may be performed to facilitate packaging. Other spent equipment will be packaged in drums or standard waste boxes.

HLW Vitrification Plant C3 Workshop Containment Building Design

The HLW vitrification plant C3 workshop containment building will be designed as a completely enclosed area within the HLW vitrification plant. It will be designed to prevent the release of dangerous waste and their exposure to the outside environment. The design and construction of the HLW vitrification plant exterior will prevent water from running into the plant. The approximate dimensions of the unit are summarized in Table 4-12.

HLW Vitrification Plant C3 Workshop Containment Building Structure

The HLW vitrification plant C3 workshop containment building will be a concrete-walled structure fully enclosed within the HLW vitrification plant. Therefore, structural requirements for the containment building will be met by the design standards of the HLW vitrification plant. The design will ensure that the unit has sufficient structural strength to prevent collapse or failure. The seismic requirements for the HLW vitrification plant are presented in *RPP-WTP Compliance with Uniform Building Code Seismic Design Requirements,* found in Supplement 1.

HLW Vitrification Plant C3 Workshop Containment Building Materials

The HLW vitrification plant C3 workshop containment building will be constructed of steel-reinforced concrete. The interior floor and a portion of the walls of the unit will be lined with stainless steel or protective coating. The roof of the HLW vitrification plant will consist of metal roofing, roof insulation, and vapor barrier. Rainwater run-off will be collected by roof drains and drainage systems with overflow roof drains.

Use of Incompatible Materials in the HLW Vitrification Plant C3 Workshop Containment Building

A stainless steel liner or protective coating will be provided for this unit. Stainless steel or the protective coating will be compatible with the equipment wastes that will be managed. Activities in the unit will be limited to decontamination, size reduction, and packaging the waste components into drums or waste boxes. Treatment reagents that could cause the liner or coating to leak, corrode, or otherwise fail will not be used within the unit.

Primary Barrier Integrity in the HLW Vitrification Plant C3 Workshop Containment Building

The HLW vitrification plant C3 workshop containment building is designed to withstand loads from the movement of personnel, wastes, and handling equipment. The seismic design criteria found in Supplement 1, ensures appropriate design loads, load combinations, and structural acceptance criteria are employed at the WTP.

Certification of Design for the HLW Vitrification Plant C3 Workshop Containment Building

Prior to startup of operations, a certification by a qualified registered professional engineer that the HLW vitrification plant C3 workshop containment building meets the design requirements of 40 CFR 264.1101(a) and (c) will be obtained. The requirements of 40 CFR 264.1101(b) do not apply to this design because the waste managed in the unit will not contain free liquids or be treated with free liquids.

Operation of the HLW Vitrification Plant C3 Workshop Containment Building

Operational and maintenance controls and practices will be established and followed to ensure containment of the wastes within the HLW vitrification plant C3 workshop containment building unit as required by 40 CFR 264.1101(c)(1).

Maintenance of the HLW Vitrification Plant C3 Workshop Containment Building

The stainless steel lining or protective coating of the unit will be constructed and maintained in a manner that will be free of significant cracks, gaps, corrosion, or other deterioration. The stainless steel liner or the protective coating will remain free of corrosion or other deterioration because it is compatible with materials that will be managed in the containment building. The failed equipment that will be managed in the containment building unit will be compatible with stainless steel or the protective coating. Only decontamination chemicals that are compatible with the liner or coating will be used.

Measures to Prevent Tracking Wastes from the HLW Vitrification Plant C3 Workshop Containment Building

The HLW vitrification plant C3 workshop containment building will be designed to isolate failed equipment from the accessible environment and to prevent the spread of contaminated materials. Very little dust is expected to be generated in the unit.

Personnel access to the containment building will be limited due to radiological concerns. It will be classified as a C3 contamination area, which allows only limited access by personnel. Personnel access will be via a C2/C3 subchange room. Equipment will enter and exit the workshop via a C2/C3 airlock. Wastes leaving the unit will be enclosed within containers. If necessary, the containers will be decontaminated in the unit prior to transportation to a permitted storage area. Equipment leaving the unit will be decontaminated, when necessary, before being released for removal from the cells.

Control of Fugitive Dust from the HLW Vitrification Plant C3 Workshop Containment Building

The following measures will be used to prevent fugitive dust from escaping the HLW vitrification plant C3 workshop containment building:

- A cascading air flow from areas of least to greatest potential contamination (i.e., C2 to C3 to C5)
- Intake air through controlled air in-bleed units, with backflow prevention dampers
- Dual HEPA filtration of exhaust air before discharge to the atmosphere through a monitored stack
- A multiple fan extraction system designed to maintain negative pressure and cascading air flow, even during fan maintenance and repair
- Personnel ingress and egress through airlocks and subchange rooms

Procedures in the Event of Release or Potential for Release from the HLW Vitrification Plant C3 Workshop Containment Building

The design and operation of the unit makes it very unlikely that releases will occur. The design and operational measures will minimize the generation of dust and contain it within the unit. The ventilation system will also use negative air pressure to keep contamination from areas of lesser contamination, and will use two-stage HEPA filtration to reduce the release of particles.

Inspections will identify conditions that could lead to a release. Such conditions will be corrected as soon as possible after they are identified. In the unlikely event that a release of dangerous wastes from the containment building is detected, actions required by 40 CFR 264.1101(c)(3)(i) through (iii) will be taken. Specific administrative and operating methods that will be used to satisfy this requirement will be developed prior to the start of operations. These methods will be followed to repair conditions that could lead to a release.

Inspections of the HLW Vitrification Plant C3 Workshop Containment Building

An inspection program will be established to detect conditions that could lead to a release of wastes from the HLW vitrification plant C3 workshop containment building. The inspection and monitoring schedule and methods that will be used to detect releases from the unit is included in Chapter 6.

4.2.4.11 HLW Vitrification Plant Air Filtration Containment Building

The HLW vitrification plant air filtration containment building is located in the northwest portion of the plant. The HLW vitrification plant air filtration containment building will manage spent HEPA and HEME filters via an overhead crane. The crane transports the spent filters to a size reduction station and then places them inside a disposal container. The disposal container is then transported via cart, through an air lock and shield doors and to a load out area for storage pending final disposal. The containment building also houses a hands-on crane decontamination and repair area.

HLW Vitrification Plant Air Filtration Containment Building Design

The HLW vitrification plant air filtration containment building will be completely enclosed within the HLW vitrification plant, and will be designed to prevent the release and exposure of dangerous constituents to the outside environment. The design and construction of the HLW vitrification plant exterior will prevent water from running into the plant. The approximate dimensions of the containment building are summarized in Table 4-12.

HLW Vitrification Plant Air Filtration Containment Building Structure

Because the HLW vitrification plant air filtration containment building will be a concrete-walled structure fully enclosed within the HLW vitrification plant, its requirements will be met by the design standards of the HLW vitrification plant. The design will ensure that the unit has sufficient structural strength to prevent collapse or failure. The seismic requirements for the HLW vitrification plant are presented in the *RPP-WTP Compliance with Uniform Building Code Seismic Design Requirements*, found in Supplement 1.

HLW Vitrification Plant Air Filtration Containment Building Materials

The HLW vitrification plant air filtration containment building will be constructed of steel-reinforced concrete. The interior floor and a portion of the walls will be lined with a protective coating. The roof of the HLW vitrification plant will consist of metal roofing, roof insulation, and a vapor barrier. Run-on will be collected by roof drains and a drainage system with overflow drains.

Use of Incompatible Materials for the HLW Vitrification Plant Air Filtration Containment Building

A protective coating will be provided for the containment building. The coating will be compatible with the wastes that will be managed in the unit, which will include spent HEPA and HEME filters. Activities in the unit will be limited to size reduction and waste packaging. Treatment reagents that could cause the protective coating to leak, corrode, or otherwise fail will not be used within the unit.

Primary Barrier Integrity in the HLW Vitrification Plant Air Filtration Containment Building

The HLW vitrification plant air filtration containment building will be designed to withstand loads from the movement of personnel, wastes, and handling equipment. The seismic design criteria found in Supplement 1, ensures appropriate design loads, load combinations, and structural acceptance criteria are employed at the WTP.

Certification of Design for the HLW Vitrification Plant Air Filtration Containment Building

Prior to the start of operations, certification by a qualified registered professional engineer that the HLW vitrification plant air filtration containment building meets the design requirements of 40 CFR 264.1101(a) and (c) will be obtained. The requirements of 40 CFR 264.1101(b) do not apply to this design because waste containing free liquids will not be managed in the unit and waste will not be treated with free liquids.

Operation of the HLW Vitrification Plant Air Filtration Containment Building

Operational and maintenance controls and practices will be established to ensure containment of the waste within the HLW vitrification air filtration containment building, as required by 40 CFR 264.1101(c)(1).

Maintenance of the HLW Vitrification Plant Air Filtration Containment Building

The protectively-coated concrete floor and walls of the unit will be constructed and maintained in a manner that will be free of significant cracks, gaps, corrosion, or other deterioration. The protective coating will be compatible with materials that will be managed in the containment building, which will include spent HEPA and HEME filters. No decontamination chemicals that are incompatible with the coated concrete will be used.

Measures to Prevent Tracking Wastes from the HLW Vitrification Plant Air Filtration Containment Building

The HLW vitrification plant air filtration containment building is designed to manage spent HEPA and HEME filters. Conducting these activities in a C3 zone will prevent the spread of contaminated materials. Limited personnel access and controlled movement of equipment into and out of the unit will decrease the possibility that waste will be tracked from the unit.

Personnel access to the HLW vitrification plant air filtration containment building, which is classified as a C3 contamination area, will be limited due to radiological concerns. Access to the unit will be allowed only under limited circumstances, thereby limiting the potential for contacting the waste and tracking it from the unit.

Control of Fugitive Dust from the HLW Vitrification Plant Air Filtration Containment Building

The following measures will be used to prevent fugitive dust from escaping the HLW vitrification plant air filtration containment building unit.

- A cascading air flow from areas of least to greatest potential contamination (i.e., C2 to C3 to C5)
- Greater negative air pressure in the unit, compared with adjacent C2 units, to pull air into the unit and prevent backflow
- Intake air through controlled air in-bleed units, with backflow prevention dampers
- HEPA filtration of exhaust air before discharge to the atmosphere through a monitored stack
- A multiple fan extraction system designed to maintain negative pressure, and cascading air flow, even during fan maintenance and repair
- Personnel ingress and egress through airlocks and subchange rooms

Procedures in the Event of Release or Potential for Release from the HLW Vitrification Plant Air Filtration Containment Building

Conditions that could lead to a release from the HLW vitrification plant air filtration containment building will be corrected as soon as possible after they are identified. The ventilation system and airlocks, the most likely sources of potential releases, will be designed with backup HEPA filters to facilitate repairs and replacement.

In the unlikely event of a release of dangerous wastes from the containment building, actions required by 40 CFR 264.1101(c)(3)(i) through (iii) will be taken. Specific administrative and operating methods that will be used to satisfy this requirement will be developed prior to the start of operations.

Inspections of the HLW Vitrification Plant Air Filtration Containment Building

An inspection program will be established to detect conditions that could lead to a release of wastes from the HLW vitrification plant air filtration containment building. The inspection and monitoring schedule, and methods that will be used to detect releases from the unit, are included in Chapter 6.

4.2.4.12 HLW Vitrification Plant Drum Transfer Tunnel Containment Building

The HLW vitrification plant drum transfer tunnel containment building stretches east to west, nearly the entire length of the HLW vitrification plant. Typical waste management activities performed in this containment building include size reduction, storage of uncontainerized waste, and packaging of failed and spent equipment.

HLW Vitrification Plant Drum Transfer Tunnel Containment Building Design

The HLW vitrification plant drum transfer containment building will be completely enclosed within the HLW vitrification plant, and will be designed to prevent the release and exposure of dangerous constituents to the outside environment. The design and construction of the HLW vitrification plant exterior will prevent water from running into the plant. The approximate dimensions of the containment building are summarized in Table 4-12.

HLW Vitrification Plant Drum Transfer Tunnel Containment Building Structure

Because the HLW vitrification plant drum transfer tunnel containment building will be a concrete-walled structure fully enclosed within the HLW vitrification plant, its requirements will be met by the design standards of the HLW vitrification plant. The design will ensure that the unit has sufficient structural strength to prevent collapse or failure. The seismic requirements for the HLW vitrification plant are presented in the *RPP-WTP Compliance with Uniform Building Code Seismic Design Requirements*, found in Supplement 1.

HLW Vitrification Plant Drum Transfer Tunnel Containment Building Materials

The HLW vitrification plant drum transfer tunnel containment building will be constructed of steel-reinforced concrete. The interior floor and a portion of the walls will be lined with a protective coating. The roof of the HLW vitrification plant will consist of metal roofing, roof insulation, and a vapor barrier. Run-on will be collected by roof drains and a drainage system with overflow drains.

Use of Incompatible Materials for the HLW Vitrification Plant Drum Transfer Tunnel Containment Building

A protective coating will be provided for the containment building. The coating will be compatible with the wastes that will be managed in the unit, which will include out-of-service process equipment, including pumps, valve, filters, jumpers, and maintenance equipment. Reagents that could cause the liner to leak, corrode, or otherwise fail will not be used within the unit.

Primary Barrier Integrity in the HLW Vitrification Plant Drum Transfer Tunnel Containment Building

The HLW vitrification plant drum transfer tunnel containment building will be designed to withstand loads from the movement of wastes and handling equipment. The seismic design criteria found in Supplement 1, ensures appropriate design loads, load combinations, and structural acceptance criteria are employed at the WTP.

Certification of Design for the HLW Vitrification Plant Drum Transfer Tunnel Containment Building

Prior to the start of operations, certification by a qualified registered professional engineer that the HLW vitrification plant drum transfer tunnel containment building meets the design requirements of 40 CFR 264.1101(a), (b), and (c) will be obtained.

Operation of the HLW Vitrification Plant Drum Transfer Tunnel Containment Building

Operational and maintenance controls and practices will be established to ensure containment of the waste within the HLW vitrification plant drum transfer tunnel containment building, as required by 40 CFR 264.1101(c)(1).

Maintenance of the HLW Vitrification Plant Drum Transfer Tunnel Containment Building

The protectively-coated concrete floor and walls of the unit will be constructed and maintained in a manner that will be free of significant cracks, gaps, corrosion, or other deterioration. The protective coating will be compatible with materials that will be managed in the containment building, which will include the out-of-service process equipment and containerized waste and equipment. No decontamination chemicals that are incompatible with the coated concrete will be used.

Measures to Prevent Tracking Wastes from the HLW Vitrification Plant Drum Transfer Tunnel Containment Building

The HLW vitrification plant drum transfer tunnel containment building is designed to provide a means to dispose of spent equipment by providing lifting, holding, and transporting of disposal containers. The unit also supports size reduction and packaging of waste containers. Conducting these activities in a C3 zone will prevent the spread of contaminated materials. Limited personnel access and controlled movement of equipment into and out of the unit will decrease the possibility that waste will be tracked from the unit.

Personnel access to the HLW vitrification plant drum transfer tunnel containment building, which is classified as a C3 contamination area, will be limited due to radiological concerns. Access to the unit will be allowed only under limited circumstances, thereby limiting the potential for contacting the waste and tracking it from the unit.

Control of Fugitive Dust from the HLW Vitrification Plant Drum Transfer Tunnel Containment Building

The following measures will be used to prevent fugitive dust from escaping the HLW vitrification plant drum transfer tunnel containment building unit:

- A cascading air flow from areas of least to greatest potential contamination (i.e., C2 to C3 to C5)
- Greater negative air pressure in the unit, compared with adjacent C2 units, to pull air into the unit and prevent backflow
- Intake air through controlled air in-bleed units, with backflow prevention dampers
- Dual HEPA filtration of exhaust air before discharge to the atmosphere through a monitored stack
- A multiple fan extraction system designed to maintain negative pressure, and cascading air flow, even during fan maintenance and repair
- Personnel ingress and egress through airlocks and subchange rooms

<u>Procedures in the Event of Release or Potential for Release from the HLW Vitrification Plant Drum Transfer Tunnel Containment Building</u>

Conditions that could lead to a release from the HLW vitrification plant drum transfer tunnel containment building will be corrected as soon as possible after they are identified. The ventilation system and airlocks, the most likely sources of potential releases, will be designed with backup HEPA filters to facilitate repairs and replacement.

In the unlikely event of a release of dangerous wastes from the containment building, actions required by 40 CFR 264.1101(c)(3)(i) through (iii) will be taken. Specific administrative and operating methods that will be used to satisfy this requirement will be developed prior to the start of operations.

<u>Inspections of the HLW Vitrification Plant Drum Transfer Tunnel Containment Building</u>

An inspection program will be established to detect conditions that could lead to a release of wastes from the HLW vitrification plant drum transfer tunnel containment building. The inspection and monitoring schedule, and methods that will be used to detect releases from the unit, are included in Chapter 6.

4.3 OTHER WASTE MANAGEMENT UNITS

Sections 4.3.1 through 4.3.5 discuss the applicability of the requirements for waste management units that have not been discussed up to this point in the DWPA. Sections 4.3.6 through 4.3.9 describe the applicability of air emission controls, waste minimization, groundwater monitoring, and functional design requirements to the WTP. References to other sections of the DWPA are provided as appropriate.

4.3.1 Waste Piles [D-3]

The operation of the WTP does not involve the placement of dangerous waste in waste piles. Therefore, the requirements of WAC 173-303-660, "Waste Piles," do not apply to the WTP.

4.3.2 Surface Impoundments [D-4]

The operation of the WTP does not involve the placement of dangerous waste in surface impoundments. Therefore, the requirements of WAC 173-303-650, "Surface Impoundments," do not apply to the WTP.

4.3.3 Incinerators [D-5]

The WTP does not include a dangerous waste incinerator. Therefore, the requirements of WAC 173-303-670, "Incinerators," do not apply to the WTP.

4.3.4 Landfills [D-6]

The operation of the WTP does not involve the placement of dangerous waste in landfills. Therefore, the requirements of WAC 173-303-665, "Landfills," do not apply to the WTP.

4.3.5 Land Treatment [D-7]

The operation of the WTP does not involve the land treatment of dangerous waste. Therefore, the requirements of WAC 173-303-655, "Land Treatment," do not apply to the WTP.

4.3.6 Air Emissions Control [D-8]

Information regarding air emissions control is provided in the following sections:

- Pretreatment vessel ventilation system description – Section 4.1.2.17
- LAW vitrification off-gas treatment system description – Section 4.1.4.3
- HLW vitrification off-gas treatment system description – Section 4.1.5.3
- Process vents – (40 CFR Part 264 Subpart AA) – Section 4.2.2.10.2
- Equipment leaks (40 CFR Part 264 Subpart BB) – Section 4.2.2.10.3
- Tanks and containers (40 CFR Part 264 Subpart CC) – Section 4.2.2.10.4

4.3.7 Waste Minimization [D-9]

Waste minimization information is presented in Chapter 10 of the permit application.

4.3.8 Groundwater Monitoring for Land-Based Units [D-10]

The groundwater monitoring requirements found in WAC 173-303-645, "Releases from regulated units," do not apply to the WTP, since it is not operated as a regulated dangerous waste surface impoundment, landfill, land treatment area or waste pile, as defined in WAC 173-303-040. Therefore, groundwater monitoring is not required.

4.3.9 Functional Design Requirements

The WTP will be designed to comply with applicable design codes and specifications. The *Basis of Design* (BNI 2001) provides the design basis for the structures, systems, and components of the WTP.

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Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
B19A (BB)	Uniform Plumbing Code (WV) Potable Water	Based on Design 130 @ 200	CL 150 B16.24	0.240	Copper 3/8" - 4", Type L	Cast Copper Alloy	Cast Copper Alloy	Cast Bronze/ Cast Iron	Bronze	Neoprene/ Red Rubber/ EPDM
C12A (CA)	ASME B31.3, Normal Fluid Service (GQ) Process Air (GK) 150 Psig Air (GN) Nitrogen (GA) Argon (WB) Cooling Water Supply (WC) Cooling Water Return (WK) Chilled Water Supply (WL) Chilled Water Return (ZA) Non-Dangerous, Non-Radioactive Liquid Effluent	Based on ASME B16.5 285 @ –20/100 200 @ 400	CL 150 B16.5	0.0625	Carbon Steel 1/2" - 1 1/2", XS 2" – 24", STD 30", STD	Carbon Steel	Carbon Steel	Carbon Steel	13CR-HF S	304 SS Spiral-Wound /ASME B16.20
C12B (CB)	ASME B31.3, Normal Fluid Service (DB, (DC), (DL) Steam (ZU) Non-Radioactive Condensate	Based on ASME B16.5 285 @ –20/100 200 @ 400	CL 150 B16.5	0.0625	Carbon Steel 1/2" - 1 1/2", XS 2" - 24", STD	Carbon Steel	Carbon Steel	Carbon Steel	13CR-HF S	304 SS Spiral-Wound /ASME B16.20

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
C12D (CD)	ASME B31.3, Normal Fluid Service (XM) Fuel Oil (XK) Diesel Oil	Based on ASME B16.5 285 @ –20/100 260 @ 200	CL 150 B16.5	0.0625	Carbon Steel 1/2” - 1 1/2”, XS 2” - 4”, STD	Carbon Steel	Carbon Steel	Carbon Steel	13CR-HF S	304 SS Spiral-Wound /ASME B16.20
C12E (CE)	NFPA 13 (WF) Fire Protection, Aboveground	Based on Design 175 @ 120	CL 150 B16.5	0.1000	Carbon Steel. 3/4” – 1”, Sch. 160 1 1/2 – 2”, XS 3” – 20”, STD	Carbon Steel	Malleable Iron	Cast Bronze Cast Iron	Bronze Ductile Iron	Neoprene
C12U (CU)	ASME B31.3, Normal Fluid Service (GK) Compressed Air, Underground (GQ) Ditto	Based on ASME B16.5 285 @ –20/100 200 @ 400	CL 150 B16.5	0.0625	Carbon Steel, Externally Coated 1/2” – 1 1/2”, XS 2” – 24” STD	Carbon Steel, Externally Coated	Carbon Steel, Externally Coated	Carbon Steel, Externally Coated	13CR-HF	304 SS Spiral-Wound /ASME B16.20
C14A (CK)	ASME B31.3, Normal Fluid Service (WF) River Water (WP) Process Water	Based on ASME B16.5 285 @ –20/100 200 @ 400	CL 150 B16.5	0.125	Carbon Steel 1/2” – 2”, XS 3” – 24”, STD	Carbon Steel	Carbon Steel	Carbon Steel	13CR-HF S	304 SS Spiral-Wound /ASME B16.20

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
CK1M (CM)	ASME B31.3, Normal Fluid Service (CH) High Pressure Air (CN) High Pressure Nitrogen	Based on Design 4,000 @ 200	CL 2500 B16.5	0.0312	Carbon Steel 1/2” – 6”, XXS	Carbon Steel	Carbon Steel	Carbon Steel	13CR-HF S	Soft Iron RTJ/ ASME B16.20
CK2N (CN)	ASME B31.3, Normal Fluid Service (WQ) High Pressure Water, 3675 Psig	Based on Design 3,675 @ 200	CL 2500 B16.5	0.0625	Carbon Steel 1/2” – 6”, XXS	Carbon Steel	Carbon Steel	Carbon Steel	13CR-HF S	Soft Iron RTJ/ ASME B16.20
F10A (FA)	ASME B31.3, Category M Fluid Service Radioactive, Dangerous Liquid Effluent Line	Based on Design 150 @ 200	CL 150 B16.5	0.000	Double Containment Fiberglass Reinforced Thermosetting Resin	Double Contain-ment Fiberglass Reinforced Thermosetting Resin	Double Contain-ment Fiberglass Reinforced Thermo-setting Resin	PVDF	EPDM/ Viton	EPDM/ Viton
G12A (CW)	Uniform Plumbing Code (WV) Potable Water	Based on Design 200 @ 150	CL 150 B16.5	0.050	Carbon Steel, Galvanized 1/2” – 3”, XS 4” – 12”, STD	Ductile Iron, Galvanized	Malleable Iron, Galvanized	Cast Bronze/ Ductile Iron	Bronze	EPDM

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
H00A (JB)	Uniform Plumbing Code (WV) Potable Water	Based on Design 200 @ 150	TBD	0.000	Cement Mortar Lined Ductile Iron Pressure Pipe	Cement Mortar Lined Ductile Iron	None	None		Synthetic Rubber
LE0A (JA)	NFPA 24 (WF)Fire Protection, Underground	Based on Design 175 @ Ambient	CL 125 B16.1	0.000	Cement Mortar Lined Ductile Iron Pressure Pipe	Cement Mortar Lined Ductile Iron or Gray Iron	None	Cast Iron	Cast Iron/ Bronze	Rubber or Neoprene
N11E (TE)	ASME B31.3, Category M Fluid Service Highly Corrosive Process Fluids in High Active Cells	Based on Design 110 @ 360	No Flanges	0.0312	Hastelloy C-276 1/2" – 2", Sch. 40S 3" – 8", Sch. 10S	Hastelloy C-276	Hastelloy C-276	No Valves	No Valves	No Gaskets

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
N11F (TF)	ASME B31.3, Category M Fluid Service (ZF) Plant Washings	Based on Design 100 @ 200	TBD	0.0425	SS AL-6XN (UNS N08367) 1/2" – 4", Sch. 40S 6" – 24", Sch 10S 30", Sch 10S	SS AL-6XN (UNS N08367)	SS AL-6XN (UNS N08367)	TBD	TBD	TBD
N13A	ASME B31.3, Category M Fluid Service TBD	Based on Design 10 @ 600	TBD	0.093	Hastelloy C-22 (UNS N06022)	Hastelloy C-22 (UNS N06022)	TBD	TBD	TBD	TBD
N31C (TC)	ASME B31.3, Category M Fluid Service (TBD) In-Cell Process Piping (TBD) In-Cell Caustic Lines	Based on Design 20 @ 520	None	0.0312	Inconel 600 1/2" – 2", Sch. 40S 3" – 6", Sch. 10S	Inconel 600	Inconel 600	No Valves	No Valves	No Gaskets
P10A (PA)	Uniform Plumbing Code (WB) Potable Water, Underground	Based on Design 200 @ 73 124 @ 100 80 @ 120	TBD	0.000	PVC 1" – 2", Sch. 80 3" – 12", Pressure Class 200	PVC	PVC	1" –2", Bronze 3" – 12", Cast Iron/ Internally Coated	Bronze	Synthetic Rubber/ ASTM F477

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
P10C (PC)	ASME B31.3, Category D Fluid Service Underground Services: (WE) Demineralized Water (WR) River Water (WB) Cooling Water Supply (WC) Cooling Water Return (ZA) Non-Dangerous, Non-Radioactive Liquid Effluent (WK) Chilled Water Supply (WL)Chilled Water Return	Based on Design 150 @ 0/100	CL 150 B16.5	0.000	PVC 12" & Smaller, Sch. 80	PVC	PVC	PVC	PVC/Vito n	EPDM
P10E (PE)	ASME B31.3, Category D Fluid Service (WY) Sewer	Based on Design 150 @ 73 60 @ 120	CL 150 B16.5	0.000	PVC 12" & Smaller, Sch. 40	PVC	PVC	PVC	PVC/ Viton	Neoprene
P10F (PF)	ASME B31.3, Category D Fluid Service (WY) Sanitary Sewer Tile Drain	Gravity @ Ambient/120	CL 150 B16.5	0.000	PVC 4", SDR 35	PVC	None	None	None	Neoprene

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
S10A (SA)	ASME B31.3, Category Normal Fluid Service (GL) Instrument Air	Based on ASME B16.5 230 @ –20/100 195 @ 200	CL 150 B16.5	0.000	304L SS 1/2" – 2", Sch. 40S 3" – 24", Sch. 10S	304L SS	304L SS	304L SS	316SS-HFS	316 SS Spiral-Wound /ASME B16.20
S11B (SB)	ASME B31.3, Category M Fluid Service In-Cell Piping with < 2% Solids (Process, Services, Reagents, and Vessel Vents)	Based on ASME B16.5, Class 150 230 @ –20/100 166 @ 360	No Flanges	0.0312	316L SS 1/2" – 2", Sch. 40S 3" – 24", Sch. 10S	316L SS	316LSS	TBD	TBD	None

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
S11C (SC)	ASME B31.3, Category Normal Fluid Service (ZS) Process Radioactive Condensate (ZR) Suspect Radioactive Condensate (WG) Re-circulated Emergency Cooling Suspect Radioactive (WS) Recirculated Cooling Suspect Radioactive (WE) Demineralized Water (WD) Inhibited Water (ZB) Biocides (ZC) Corrosion Inhibitors	Based on ASME B16.5 230 @ –20/100 166 @ 360	CL 150 B16.5	0.0312	316L SS 1/2” – 2”, Sch. 40S 3” –14”, Sch. 10S 16” – 20, 0.250” nom. 24” 0.312” nom.	316L SS	316L SS	316L SS	316SS-HFS	316 SS Spiral-Wound /ASME B16.20

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
S11F (SF)	ASME B31.3, Category M Fluid Service In-Cell Piping with < 2% Solids (Process, Services, Reagents, and Vessel Vents that Contain Nitric Acid)	Based on ASME B16.5 , Class 150 230 @ –20/100 166 @ 360	No Flanges	0.0312	304L SS 1/2" – 2", Sch. 40S 3" – 24", Sch. 10S	304L SS	304L SS	TBD	TBD	None
S11G (SG)	ASME B31.3, Category Normal Fluid Service (XL) Lubricating Oil (XH) Hydraulic Oil (XJ) Transformer Oil	Based on ASME B16.5 230 @ –20/100 195 @ 200	CL 150 B16.5	0.0312	304L SS 1/2" – 2", Sch. 40S 3" – 10", Sch 10S	304L SS	304L SS	304L SS	316SS-HF S	316 SS Spiral-Wound /ASME B16.20

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
S11K (SK)	ASME B31.3, Category Norm Fluid Service (GM) Ammonia (RC) Calcium Nitrate (RL) Potassium Permanganate (RK) Sodium Permanganate (RQ) 1M Strontium Nitrite (PV) Strontium Carbonate Ammonium Hydroxide (RN) 0.5M Sodium Nitrite (JS) 0.5M Sodium Hydroxide (JS) 5M Sodium Hydroxide (ZK) Fresh Ion Exchange [IX] Resin (ZM) Off-Specification Resin	Based on ASME B16.5 230 @ – 20/100	CL 150 B16.5	0.0312	304L SS 1/2" – 2", Sch. 40S 3" – 14", Sch. 10S 16" – 20", 0.250" nom. 24", 0.312" nom.	304L SS	304L SS	304L SS	316L SS-HFS	316 SS Spiral-Wound /ASME B16.20

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
S11M (SM)	ASME B31.3, Category M Fluid Service (GV) Radioactive Vessel Vent (PW) Radioactive Gas/Vapor (ZE) Plant Wash Solvent (ZF) Plant Washings (ZH) Acidic Effluents (ZJ) Alkaline Effluents (ZL) Spent Ion Exchange Resin (ZN) Neutralized Effluent (ZY) Scrubber Effluent	Based on ASME B16.5 230 @ –20/100	CL 150 B16.5	0.0312	316L SS 1/2" – 2", Sch. 40S 3" – 24", Sch. 10S	316L SS	316L SS	316L SS	316L SS-HFS	316 SS Spiral-Wound /ASME B16.20
S11P (TB)	ASME B31.3, Category M Fluid Service (ZT) Thermocouple Sheathed Line In Cell	Based on ASME B16.5 230 @ –20/100	None	0.0312	316L SS 1/2" - 3/4", Sch. 10S	None	No fitting, Use Type 316L Jointing Sleeve	No Valves	No Valves	No Gaskets

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
S11R (SR)	ASME B31.3, Category Norm Fluid Service (HN) 0.5M Nitric Acid (HN) 2M Nitric Acid (HN) 5M Nitric Acid (HN) 12.2M Nitric Acid (HR) Recovered Nitric Acid (HT) Citric Acid (SDG3) (GU) Nitric Acid Fume	Based on ASME B16.5 230 @ –20/100	CL 150 B16.5	0.0312	304L SS 1/2" – 2", Sch. 40S 3" – 14", Sch 10S 16" – 20", 0.250" nom. 24", 0312" nom.	304L SS	304L SS	304L SS	304L SS-HFS	304SS Spiral-Wound /ASME B16.20
S11Y (SY)	ASME B31.3, Category M Fluid Service (ZG) Pneumercator Line (ZP) Pneumatic Sample Line (ZQ) Pneumatic Service Line	Based on ASME B16.5 230 @ –20/100	TBD	0.0312	316L SS 1/2" – 3/4", Sch. 40S	None	316L SS	No Valves	No Valves	No Gaskets

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
S12A (LB)	ASME B31.3, Category M Fluid Service In-Cell Piping with ≥2% solids (Process, Services, Reagents, and Vessel Vents)	Based on ASME B16.5, Class 150 230 @ –20/100 166 @ 360	No Flanges	0.0625	316L SS 1/2” – 2”, Sch. 40S 3” – 14”, Sch. 10S 16” – 24”, 0250” nom.	316L SS	316L SS	TBD	TBD	None
S12C (LE) (>2% solids)	ASME B31.3, Category M Fluid Service (PA) Radioactive Aqueous (PX) Radioactive Slurry	Based on ASME B16.5 230 @ –20/100	CL 150 B16.5	0.0625	316L SS 1/2” – 2”, Sch. 40S 3” – 14”, Sch. 10S 16” – 24”, 0.250” nom.	316L SS	316L SS	316L SS	316L SS	316 SS Spiral-Wound /ASME B16.20
S12D (LF)	ASME B31.3, Category M Fluid Service In-Cell Piping with ≥ 2% Solids (Process, Services, Reagents, and Vessel Vents that Contain Nitric Acid)	Based on ASME B16.5, Class 150 230 @ –20/100 166 @ 360	No Flanges	0.0625	304L SS 1/2” – 2”, Sch. 40S 3” – 14”, Sch. 10S 16” – 24”, 0.250” nom.	304L SS	304L SS	TBD	TBD	None

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
S14D (TD)	ASME B31.3, Category M Fluid Service (FX) Mixed Glass Former Solids high erosion	Based on ASME B16.5 230 @ – 20/100 195 @ 200	CL 150 B16.5	0.125	316L SS 1/2" – 1", Sch. 160 1 1/2" – 2", Sch. 80S 3" – 12", Sch. 40S	316L SS	316L SS	316L SS	316L SS-HFS	316 SS Spiral-Wound /ASME B16.20
S30J (SJ)	ASME B31.3, Normal Fluid Service Liquid Carbon Dioxide	Based on Design 300 @ – 50	CL 300 B16.5	0.000	304L SS 1/2" –2", Sch. 40S 3" – 12, Sch. 10S	304L SS	304L SS	304L SS	(Later)	316 SS Spiral-Wound /ASME B16.20
S31H (SH)	ASME B31.3, Category M Fluid Service <2% Solids In-Cell Piping (Process and Vessel Vents)	Based on ASME B16.5 600 @ – 20/100 505 @ 200	CL 300 B16.5	0.0312	316L SS 1/2" – 12", Sch. 40S	316L SS	316L SS	TBD	TBD	None
S31T (ST)	ASME B31.3, Category M Fluid Service Service Bulges, Process Bulges, Cabinets	Based on Design 385 @ 400	CL 300 B16.5	0.0312	316L SS 1/2" – 12", Sch. 40S	316L SS	316L SS	316L SS	316L SS-HFS	316 SS Spiral-Wound /ASME B16.20

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
S31U (SU)	ASME B31.3, Category M Fluid Service < 2% Solids In-Cell Piping (Process, and Vessel Vents that Contain Nitric Acid))	Based on ASME B16.5 600 @ –20/100 505 @ 200	CL 300 B16.5	0.0312	304L SS 1/2" – 12", Sch. 40S	304L SS	304L SS	TBD	TBD	None
S32A (LH)	ASME B31.3, Category M Fluid Service ≥ 2% Solids In-Cell Piping (Process and Vessel Vents)	Based on ASME B16.5 600 @ –20/100 505 @ 200	CL 300 B16.5	0.0625	316L SS 1/2" – 12", Sch. 40S 14", 0.375" nom. 16" – 18", 0.437" nom. 20", 0.500" nom. 24", 0.562" nom.	316L SS	316L SS	TBD	TBD	None

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
S32B (LW) (≥ 2% Solids)	(PE) Entrained Solids Concentrate; (PJ) HLW Melter Feed; (PC) HLW Feed Slurry	Double Containment Pipe								
	INNER PIPE	ASME B31.3, Category M Fluid Service	Based on Design 400 @ 160	TBD	0.0625	316L SS 1/2" – 4", Sch. 40S	None - Use Bends for Directional Change	No Valves	No Valves	None
	OUTER PIPE	ASME B31.3, Category D Service Fluid	TBD	TBD	0.0000	316L SS 4" – 8", Sch. 10S	Not Permitted Except Where Fitting Radius Equals Bend Radius	No Valves	No Valves	None
S62A (LU)	ASME B31.3, Category M Fluid Service ≥ 2% Solids In-Cell Piping (Process and Vessel Vents that Contain Nitric Acid)	Based on ASME B16.5 600 @ – 20/100 505 @ 200	CL 300 B16.5	0.0625	304L SS 1/2" – 12", Sch. 40S 14", 0.375" nom. 16" – 18", 0.437" nom. 20", 0.500" nom. 24", 0.562" nom.	304L SS	304L SS	TBD	TBD	None

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
SJ0E (SE)	ASME B31.3, Category Normal Fluid Service (GL) Instrument Air Back Up	<u>Based on ASME B16.5</u> 3000 @ –20/100 2530 @ 200	CL 1500 B16.5	0.000	304L SS 1/2” -1”, Sch. 80S 1 1/2”, 0.250” nom 2”, 0.312” nom. 3”, 0.437” nom.	304L SS	304L SS	304L SS	316SS-HFS	Soft Iron RTJ/ ASME B16.20
T11A (ZA)	ASME B31.3, Category M Fluid Service (HC) Cerium De-contaminant (ZX) Special De-contaminant	<u>Based on Design</u> 120 @ 360	None	0.0312	Titanium (ASTM B337 Gr. 2) 1/2” – 2”, Sch. 40S 3” – 6”, Sch. 10S	Titanium	Titanium	No Valves	No Valves	None
W31A (WA) (< 2% Solids)	Radioactive Effluent (LA Effluents/Process Fluids) (PF) Cs/Tc Concentrate/ Intermediate Product	Double Containment Pipe								
	INNER PIPE	ASME B31.3, Category M Fluid Service	<u>Based on Design</u> 400 @ 160	TBD	0.0312	316L SS 1/2” – 2”, Sch. 40S 3” – 4”, Sch. 10S	None - Use Bends for Directional Change	No Valves	No Valves	None

Table 4-1 Example Piping Material Service Class Index

Class (Old)	Design Code/Service	Press/Temp Limits Psig @ °F	Flange Pressure Class	Corrosion/ Erosion Allow (in.)	Pipe	Large Fittings	Small Fittings	Valve Body	Valve Trim	Gasket
	OUTER PIPE	ASME B31.3, Category D Service Fluid	TBD	TBD	0.0000	316L SS 4" – 8", Sch. 10S	Not Permitted Except Where Elbow Radius Equals Bend Radius	No Valves	No Valves	None
W62F (XA)	DST Transfer Line	Double Containment Pipe								
	INNER PIPE	ASME B31.3, Category M Fluid Service	Based on Design 1000 @ 160	None	0.0625	304L SS 1/2" – 4", Sch. 80S	None - Use Bends for Directional Change	No Valves	No Valves	None
	OUTER PIPE	ASME B31.3, Category D Fluid Service	TBD	TBD	0.0000	Carbon Steel, A106-B, Smls 4" – 8", STD	Not Permitted Except Where CS Fitting Radius Equals Bend Radius	No Valves	No Valves	None

Table 4-2 Container Storage Areas Summary

Container Storage Area	Maximum Waste Volume (gallons)	Approximate Dimensions (L × W × H, in feet)
LAW Vitrification Plant		
ILAW Buffer Container Storage Area	89,099	22 × 63 × 20
ILAW Container Storage Area	889,448	(50 × 240 × 35) + (102 × 18 × 35)
LAW Container Storage Area	80,549	(21 × 33 × 25) + (28 × 20 × 25)
HLW Vitrification Plant		
IHLW Canister Storage Area	245,504	(67 × 23 × 27) + (67 × 34 ×27)
HLW Container Storage Area No. 1	266,654	122 × 34 ×37
HLW Container Storage Area No. 2	71,999	56 × 20 × 27
HLW Container Storage Area No. 3	43,392	45 × 15 × 37
Other Areas		
Central Waste Storage Facility	617,137	80 × 120 × 10
Non-Radioactive Dangerous Waste Container Storage Area	48,214	25 × 30 × 10
HLW Melter Out-Of-Service Storage Area	202,498	70 × 45 × 35
LAW Melter Out-Of-Service Storage Area	216,962	45 × 75 × 35

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Table 4-3 Pretreatment Plant Tank Systems

No.	System	Vessel Number	Description	Material	Maximum Volume (gallons)	Approximate Dimensions (Diameter [D] × Height/Length [H/L] in inches)
1	FRP	V11020A	Waste Feed Receipt Vessel	Stainless Steel	388,000	552 × 468
2	FRP	V11020B	Waste Feed Receipt Vessel	Stainless Steel	388,000	552 × 468
3	FRP	V11020C	Waste Feed Receipt Vessel	Stainless Steel	388,000	552 × 468
4	FRP	V11020D	Waste Feed Receipt Vessel	Stainless Steel	388,000	552 × 468
5	FEP	V11001A	Evaporator Feed Vessel	Stainless Steel	59,070	264 × 336
6	FEP	V11001B	Evaporator Feed Vessel	Stainless Steel	59,070	264 × 336
7	FEP	V11002A	Waste Feed Evaporator Separator Vessel	Stainless Steel	21,240	132 × 402
8	FEP	V11002B	Waste Feed Evaporator Separator Vessel	Stainless Steel	21,240	132 × 402
9	FEP	V11005	Evaporator Process Condensate Pot	Stainless Steel	1,190	60 × 116
10	UFP	V12015A	LAW Permeate Hold Vessel	Stainless Steel	28,390	180 × 317
11	UFP	V12015B	LAW Permeate Hold Vessel	Stainless Steel	28,390	180 × 317
12	UFP	V12015C	LAW Permeate Hold Vessel	Stainless Steel	28,390	180 × 317
13	UFP	V12010A	Evaporator Concentrate Buffer Vessel	Stainless Steel	62,340	240 × 397
14	UFP	V12010B	Evaporator Concentrate Buffer Vessel	Stainless Steel	62,340	240 × 397
15	UFP	V12011A	Ultrafiltration Feed Vessel	Stainless Steel	26,840	168 × 335
16	UFP	V12011B	Ultrafiltration Feed Vessel	Stainless Steel	26,840	168 × 335
17	UFP	G12002A	Ultrafilter	Stainless Steel	140	17 × 145

Table 4-3 Pretreatment Plant Tank Systems

No.	System	Vessel Number	Description	Material	Maximum Volume (gallons)	Approximate Dimensions (Diameter [D] × Height/Length [H/L] in inches)
18	UFP	G12002B	Ultrafilter	Stainless Steel	140	17 × 145
19	UFP	G12003A	Ultrafilter	Stainless Steel	140	17 × 145
20	UFP	G12003B	Ultrafilter	Stainless Steel	140	17 × 145
21	UFP	G12004A	Ultrafilter	Stainless Steel	140	17 × 145
22	UFP	G12004B	Ultrafilter	Stainless Steel	140	17 × 145
23	HLP	V12007	HLW Feed Blending Vessel	Stainless Steel	18,070	144 × 304
24	HLP	V12001A	Strontium/transuranic Lag Storage Vessel	Stainless Steel	96,900	300 × 415
25	HLP	V12001C	Strontium/transuranic Lag Storage Vessel	Stainless Steel	96,900	300 × 415
26	HLP	V12001D	Lag Storage Vessel	Stainless Steel	96,900	300 × 415
27	HLP	V12001E	Lag Storage Vessel	Stainless Steel	96,900	300 × 415
28	CXP	C13001	Cesium Ion Exchange Column	Stainless Steel	680	42 × 126
29	CXP	C13002	Cesium Ion Exchange Column	Stainless Steel	680	42 × 126
30	CXP	C13003	Cesium Ion Exchange Column	Stainless Steel	680	42 × 126
31	CXP	C13004	Cesium Ion Exchange Column	Stainless Steel	680	42 × 126
32	CXP	V13001	LAW Feed Vessel	Stainless Steel	61,200	228 × 421
33	CXP	V13008	Caustic Rinse Collection Vessel	Stainless Steel	2,400	78 × 142
34	CNP	V13073	Eluate Contingency Storage Vessel	Stainless Steel	11,060	138 × 216

Table 4-3 Pretreatment Plant Tank Systems

No.	System	Vessel Number	Description	Material	Maximum Volume (gallons)	Approximate Dimensions (Diameter [D] × Height/Length [H/L] in inches)
35	CNP	V13028	Recovered Nitric Acid Vessel	Stainless Steel	5,410	96 × 204
36	CNP	V13030	Cesium Concentrate Lute Pot	Stainless Steel	70	17 × 36
37	TXP	V43001	Technetium Ion Exchange Buffer Vessel	Stainless Steel	18,100	156 × 270
38	TXP	C43006	Technetium Ion Exchange Column	Stainless Steel	680	42 × 126
39	TXP	C43007	Technetium Ion Exchange Column	Stainless Steel	680	42 × 126
40	TXP	C43008	Technetium Ion Exchange Column	Stainless Steel	680	42 × 126
41	TXP	C43009	Technetium Ion Exchange Column	Stainless Steel	680	42 × 126
42	TXP	V43056	Caustic Rinse Collection Vessel	Stainless Steel	3,300	96 × 137
43	TXP	V43110A	Treated LAW Buffer Vessel	Stainless Steel	33,050	168 × 400
44	TXP	V43110B	Treated LAW Buffer Vessel	Stainless Steel	33,050	168 × 400
45	TXP	V43110C	Treated LAW Buffer Vessel	Stainless Steel	33,170	168 × 401
46	TEP	V43069	Technetium Eluant Recovery Evaporator	Stainless Steel	4,300	78 × 233
47	TEP	V43071	Recovered Technetium Eluant Vessel	Stainless Steel	7,900	114 × 216
48	TEP	V43072	Technetium Concentrate Lute Pot	Stainless Steel	70	17 × 36
49	TLP	V41013	Process Condensate Hold Vessel	Stainless Steel	450	48 × 72
50	TLP	V41011	LAW Evaporator Separator Vessel	Stainless Steel	21,240	132 × 402
51	TLP	V45009A	Plant Wash Vessel	Stainless Steel	88,920	264 × 462
52	TLP	V45009B	Plant Wash Vessel	Stainless Steel	88,920	264 × 462

Table 4-3 Pretreatment Plant Tank Systems

No.	System	Vessel Number	Description	Material	Maximum Volume (gallons)	Approximate Dimensions (Diameter [D] × Height/Length [H/L] in inches)
53	TCP	V41001	LAW Buffer Storage Vessel	Stainless Steel	117,000	312 × 456
54	RDP	V43135A	Spent Resin Collection Vessel	Stainless Steel	8,720	118 × 196
55	RDP	V43135B	Spent Resin Collection Vessel	Stainless Steel	8,720	118 × 196
56	RDP	V43136	Resin Flush Collection Vessel	Stainless Steel	11,220	144 × 206
57	RLD	V45028A	Process Condensate Vessel	Stainless Steel	321,720	480 × 492
58	RLD	V45028B	Process Condensate Vessel	Stainless Steel	321,720	480 × 492
59	PWD	V15009B	Ultimate Overflow Vessel	Stainless Steel	23,000	216 × 216
60	PWD	V12002	HLW Effluent Transfer Vessel	Stainless Steel	23,000	216 × 216
61	PWD	V45013	Primary Acidic/Alkaline Effluent Vessel	Stainless Steel	49,850	216 × 385
62	PWD	V45018	Secondary Acidic/Alkaline Effluent Vessel	Stainless Steel	49,850	216 × 385
63	PWD	V15013	Alkaline Effluent Vessel	Stainless Steel	93,180	264 × 480
64	PWD	V15009A	Plant Wash Vessel	Stainless Steel	73,860	456 × 240
65	PWD	V15319	C3 Floor Drains Tank	Stainless Steel	450	36 × 72
66	PWD	V15018	Alkaline Effluent Vessel	Stainless Steel	93,180	264 × 480
67	PVP	V15052	Vessel Vent Header Collection Vessel	Stainless Steel	900	54 × 108
68	PVP	V15038	Condensate Collection Vessel	Stainless Steel	1,230	60 × 120
69	PVP	V15327	HEME Drain Collection Vessel	Stainless Steel	2,760	72 × 180

Table 4-3 Pretreatment Plant Tank Systems

No.	System	Vessel Number	Description	Material	Maximum Volume (gallons)	Approximate Dimensions (Diameter [D] × Height/Length [H/L] in inches)
70	PVP	V15326	HEME Drain Collection Vessel	Stainless Steel	820	48 × 120

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Table 4-4 LAW Vitrification Plant Tank Systems

No.	System	Vessel Number	Description	Material	Maximum Volume (gallons)	Approximate Dimensions [Diameter (D) × Height/Length (H/L) in feet]
1	LCP	V21001	Melter 1 Concentrate Receipt Vessel	Stainless Steel	14,392	13 × 17
2	LCP	V21002	Melter 2 Concentrate Receipt Vessel	Stainless Steel	14,392	13 × 17
3	LCP	V21003	Melter 3 Concentrate Receipt Vessel	Stainless Steel	14,392	13 × 17
4	LFP	V21101	Melter 1 Feed Preparation Vessel	Stainless Steel	6,221	10 × 12
5	LFP	V21102	Melter 1 Feed Vessel	Stainless Steel	6,221	10 × 12
6	LFP	V21201	Melter 2 Feed Preparation Vessel	Stainless Steel	6,221	10 × 12
7	LFP	V21202	Melter 2 Feed Vessel	Stainless Steel	6,221	10 × 12
8	LFP	V21301	Melter 3 Feed Preparation Vessel	Stainless Steel	6,221	10 × 12
9	LFP	V21302	Melter 3 Feed Vessel	Stainless Steel	6,221	10 × 12
10	LVP	V22001	LAW Caustic Scrubber Blowdown Vessel	Stainless Steel	12,191	14 × 14
11	LOP	V22101	Melter 1 SBS Condensate Vessel	Hastelloy	6,833	8 × 20
12	LOP	V22201	Melter 2 SBS Condensate Vessel	Hastelloy	6,833	8 × 20
13	LOP	V22301	Melter 3 SBS Condensate Vessel	Hastelloy	6,833	8 × 20
14	RLD	V25001	Plant Wash Vessel	Stainless Steel	25,130	14 × 26
15	RLD	V25002	LAW C3/C5 Effluent Collection Vessel	Stainless Steel	7,218	10 × 13
16	RLD	V25003	SBS Condensate Collection Vessel	Stainless Steel	24,704	16 × 18

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Table 4-5 HLW Vitrification Plant Tank Systems

No.	System	Vessel Number	Description	Material	Maximum Volume (gallons)	Approximate Dimensions (Diameter [D] × Height/Length [H/L] in feet)
1	HCP	V31001	Concentrate Receipt Vessel 1	Stainless Steel	17,900	14 × 18
2	HCP	V31002	Concentrate Receipt Vessel 2	Stainless Steel	17,900	14 × 18
3	HOP	V32101	SBS Condensate Collection Vessel	Hastelloy	10,000	12 × 14
4	HDH	V33004	Canister Bogie Decontamination Vessel	Stainless Steel	2,500	5 × 17
5	HDH	V33002	Waste Neutralization Vessel	Titanium	5,300	7 × 20
6	HDH	V33001	Canister Decontamination Vessel	Titanium	580	3 × 16
7	RLD	V35002	Acidic Waste Vessel	Stainless Steel	16,700	13 × 19
8	RLD	V35003	Plant Wash and Drains Vessel	Stainless Steel	13,200	13 × 16
9	RLD	V35009	Decontamination Effluent Collection Vessel	Stainless Steel	7,300	10 × 14
10	RLD	V35038	Off-gas Drains Collection Vessel	Stainless Steel	280	4 × 4
11	HFP	V31101	Feed Preparation Vessel	Stainless Steel	8,800	8 × 11
12	HFP	V31102	HLW Melter Feed Vessel	Stainless Steel	8,800	8 × 11

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Table 4-6 Analytical Laboratory Tank Systems

No.	System	Vessel Number	Description	Material	Maximum Volume (gallons)	Approximate Dimensions (Diameter [D] × Height/Length [H/L] in feet)
1	LAB	V60001a	Lab Liquid Effluent Collection Vessel	Stainless Steel	12,063	11 × 14
2	LAB	V60001b	Lab Liquid Effluent Collection Vessel	Stainless Steel	12,063	11× 14

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Table 4-7 Analytical Laboratory Sumps

Description	Location	Sump Type
Lab Liquid Effluent Collection	Hot Cell	II

Table 4-8 Pretreatment Plant Sumps

Description	Location	Sump Type
Plant Wash	Pit	II
LAW Feed Receipt	PA-01	II
LAW Feed Receipt	PA-01	II
Effluent Collection	PA-08	II
Waste Feed	PA-09	II
Cesium Collection	PA-10	II
Technetium Collection	PA-10	II
Technetium Ion Exchange	PA-11	II
Technetium Ion Exchange	PA-11	II
Technetium Ion Exchange Columns	PA-12	II
Treated LAW Collection	PA-13	II
Plant Wash	PA-14	II
Plant Wash	PA-14	II
Hot Cell	PA-07	II
Hot Cell	PA-07	II
Hot Cell	PA-07	II
Hot Cell	PA-07	II
Hot Cell	PA-07	II
Gross Decontamination	PA-15	II
Waste Feed Receipt	PA-02	II
Evaporator Feed	PA-03	II
Evaporator Feed	PA-03	II
Ultrafilter Feed	PA-04	II

Table 4-8 Pretreatment Plant Sumps

Description	Location	Sump Type
Ultrafilter Feed	PA-04	II
Envelope D Receipt	PA-05	II
Envelope D Receipt	PA-05	II
Primary Decontamination	PA-16	II
Final Decontamination	PA-16	II

Table 4-9 LAW Vitrification Plant Sumps

Description	Location	Sump Type
Melter 1 Pour Cave	L-062	I
Melter 2 Pour Cave	L-064	I
Melter 3 Pour Cave	L-066	I
C3/C5 Drains Vessel	L-007	I
C1/C2 Drains Tank	LC-001	I
Cooling Water Pump Room	L-015	I
C5 Filter Room	L-048	I
C5 Filter Room	L-048	I
Melter 1 Process Room	L-186	I
Melter 1 Process Room	L-186	I
Melter 2 Process Room	L-187	I
Melter 2 Process Room	L-187	I
Melter 3 Process Room	L-188	I
Melter 3 Process Room	L-188	I
Effluent Process Room	L-189	I
Effluent Process Room	L-189	I

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Table 4-10 HLW Vitrification Plant Sumps

Description	Location	Sump Type
Non-Active Effluent Collection Room	H-058	I
Canister Storage Transfer Tunnel	H-055	I
Cooling Water Plant Room	H-076	I
Process/Instrument Air Receiver Platform	HP-011A	I
Secondary Off-gas Cell	H-004	I
Drum Transfer Tunnel	H-068	I
Melter 1 Cave	H-153	II
Wet Process Cell	H-027	II
SBS Condensate Collection Cell	H-035	II
Decontamination Effluent Area	H-027	II
Canister Transfer Tunnel – Melter 2	H-022	I
Canister Transfer Tunnel – Melter 1	H-036	I
Bogie Decontamination Canister Rinse Tunnel	H-050	I
Canister Rinse Tunnel	H-051	I
Filter Cave	H-133	I
Canister Import Tunnel	H-039	I
Bogie Maintenance	H-072	I
Canister Decontamination Cell	H-059	II
Consumables Drum Transfer Tunnel	H-028	I
Comsumables Drum Transfer Tunnel	H-028	I
Cask Transfer Tunnel	H-073	I
Cansiter Handling Cave – Weld Area	H-146	I
Cansiter Handling Cave – Laydown Area	H-146	I

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Table 4-11 Secondary Containment Liner in Cells and Caves in the WTP

Cell/Cave	Approximate Cell Dimensions (L×W, in feet)	Tanks in Cell/Cave	Volume of Largest Tank in Cell/Cave (gallons)	Calculated Secondary Containment Liner Height (feet)
Pretreatment Plant				
Ultimate Overflow Pit	22 × 54	V15009B, V12002	23,000	2.6
Waste Feed Receipt Cell	53 × 217 & 52 × 53	V11020A, V11020B, V11020C, V11020D	388,000	3.7
Waste Feed Evaporation Cell	52 × 78	V11001A, V11001B, V11002A, V11002B, V12015A, V12015B, V12010A	62,340	2.1
Waste Feed Ultrafiltration Cell	52 × 94	V12010B, V12015C, V12011A, V12011B, V15009A, V12007, V15052, V15038	73,860	2.1
HLW Feed Blending and Lag Storage Cell	52 × 132	V12001A, V12001C, V12001D, V12001E, V15326, V15327	96,900	1.9
Hot Cell	54 × 367	C13001, C13002, C13003, C13004, G12002A, G12002B, G12003A, G12003B, G12004A, G12004B	680	0.1
South Process Bulge	17 × 250	V11005	1,190	0.1
Northeast Process Bulge	17 x 250	V41013	450	0.1
Northwest Process Bulge	17 x 250	V15319	450	0.1
Effluent Vessel Cell	31 × 53	V15013, V15018	93,180	7.6

Table 4-11 Secondary Containment Liner in Cells and Caves in the WTP

Cell/Cave	Approximate Cell Dimensions (L×W, in feet)	Tanks in Cell/Cave	Volume of Largest Tank in Cell/Cave (gallons)	Calculated Secondary Containment Liner Height (feet)
Cesium Ion Exchange Removal Support Cell	36 × 42	V13001, V13073, V13008	61,200	5.4
Cesium Nitric Acid Recovery Cell	17 × 22	V13028, V13030	5,410	1.9
Technetium Eluant Recovery Cell	45 × 24	V43071, V43072	7,900	3.0
Spent Resin Collection Cell	17 × 24	V43135A	8,720	0.4
Technetium Ion Exchange Resin/Buffer Cell	24 × 34 & 15 × 27	V43135B, V43001, V43136	18,100	2.0
Technetium Ion Exchange Column Cell	34 × 42	C43006, C43007, C43008, C43009, V43056	3,300	0.4
Treated LAW Buffer Storage	34 × 60	V43110A, V43110B, V43110C, V41011	33,170	2.2
LAW Buffer Vessel Cell	34 × 117	V45009A, , V41001, V45013, V45018, V45009B	117,000	4.0
Analytical Laboratory				
Effluent Collection Cell	18 × 36	V60001a, V60001b	12,063	4.0
LAW Vitrification Plant				
L-186, Melter 1 Process Cell	48 × 38	V21001, V22101, V21102, V21101	14,392	1.4
L-187, Melter 2 Process Cell	48 × 38	V21002, V22201, V21202, V21201	14,392	1.4

Table 4-11 Secondary Containment Liner in Cells and Caves in the WTP

Cell/Cave	Approximate Cell Dimensions (L×W, in feet)	Tanks in Cell/Cave	Volume of Largest Tank in Cell/Cave (gallons)	Calculated Secondary Containment Liner Height (feet)
L-188, Melter 3 Process Cell	48 × 38	V21002, V22301, V21302, V21301	14,392	1.4
L-189, Effluent Cell	38 × 31	V25001, V25003	25,130	3.7
L-333, Caustic Scrub Blowdown Collection Room	31 × 27	V22001	12,191	3.3
L-007, C3/C5 Drain Tank Room	18 × 18	V25002	7,218	11.3
HLW Vitrification Plant				
H-153, No. 1 – Tank Area	51 × 12	V31001, V31002	8,800	3.0
H-050, Canister Bogie Decontamination Room	36 × 23	V33004	2,500	1.0
H-051, Canister Rinse Bogie Tunnel	11 × 54	V33004	2,500	1.0
H-059, Canister Decontamination Cell	11 × 22	V33001, V33002	5,300	4.0
H-035, SBS Drain Collection Cell No. 1	18 × 18	V32101	10,000	10.0
H-027, Wet Process Cell (south section)	18 × 64	V35002, V35003, V31001, V31002	16,700	4.5
H-027, Wet Process Cell (north section)	17 × 18	V35009, V35038	7,300	5.0

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Table 4-12 Containment Buildings Summary

Location	Approximate Dimensions (L × W × H, in feet)
Pretreatment Plant	
Pretreatment Hot Cell Containment Building	414 × 54 × 46
Pretreatment Maintenance Containment Building	(98 × 56 × 18) + (54 × 5 × 18) + (54 × 78 × 18) + (18 × 98 × 18)
Pretreatment Air Filtration Containment Building	234 × 54 × 19
LAW Vitrification Plant	
LAW LSM Gallery Containment Building	151 × 62 × 25
ILAW Container Finishing Containment Building	98 × 31 × 25
LAW Vitrification Plant C3 Workshop Containment Building	35 × 40 × 20
HLW Vitrification Plant	
HLW Melters No. 1 and 2 Containment Buildings	35 × 107 × 49
IHLW Container Weld Containment Building	140 × 18 × 48
IHLW Container Decontamination Building	10 × 80 × 58
HLW Vitrification Plant C3 Workshop Containment Building	(30 × 27 × 19) + (33 x 15 x 19)
HLW Air Filtration Containment Building	104 × 38 × 19
HLW Drum Transfer Tunnel Containment Building	220 × 10 × 10

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Table 4-13 Categorization of Piping

Seismic Categories[a]	Seismic Category I – SC-I	Seismic Category II – SC-II	Seismic Category III - SC-III	Seismic Category IV – SC -IV
Definition	a Piping important to safety and which has a seismic safety function	a Piping important to safety, whose failure during a seismic event could prevent a Seismic Category I piping components from performing its seismic safety function	a Piping important to safety, but without seismic safety function b Piping not important to safety, but which has an inventory of radioactive or hazardous material in an amount less than an important to safety significant quantity	a Piping not important to safety and without an inventory of radioactive or hazardous material, but require seismic protection.
(I) Design Code and Analysis Methods for weight effects and thermal expansion or contraction effects				
Pipe and Supports	ASME B31.3 Code(Ref 8.1)	ASME B31.3 Code (Ref 8.1)	ASME B31.3 Code (Ref 8.1)	ASME B31.3 Code (Ref 8.1)
(II) Analysis Methods for Seismic Loads				
Pipe	NC [b]	NC/F [d]	NC/F [d]	NC/F [d]
Supports	NF [e]	NF [e]	F [c]	F [c]
Seismic Method	Response Spectrum	Response Spectrum	UBC	UBC
(III) Acceptance Criteria				
Pipe	NC [b]/B31.3	F [c]	F [c]	F [c]
Supports	NF [e]	NF [e]	F [c]	F [c]

Notes:

[a] Seismic Category V (SC-V) do not have any seismic design requirements. No analysis is required. The piping shall be installed per Building Code.

[b] NC is defined as Section NC-3650 (Analysis of Nuclear Class 2 Piping Systems) of ASME Section III Code.

[c] F is defined as Appendix F (Rules for Evaluation of Service Loadings with Level D service Limits (Faulted Condition)), as defined in ASME Section III Code.

[d] NC/F is defined to apply Appendix F to meet ASME Section III, NC Code requirements.

[e] NF is defined as Section NF (for Pipe Supports) of ASME Section III Code.

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